The Electrical Industry's Weekly Magazine

Price 50 Cent

Study 500 Kv for Pacific Northwest-California Intertie

. . . page 58

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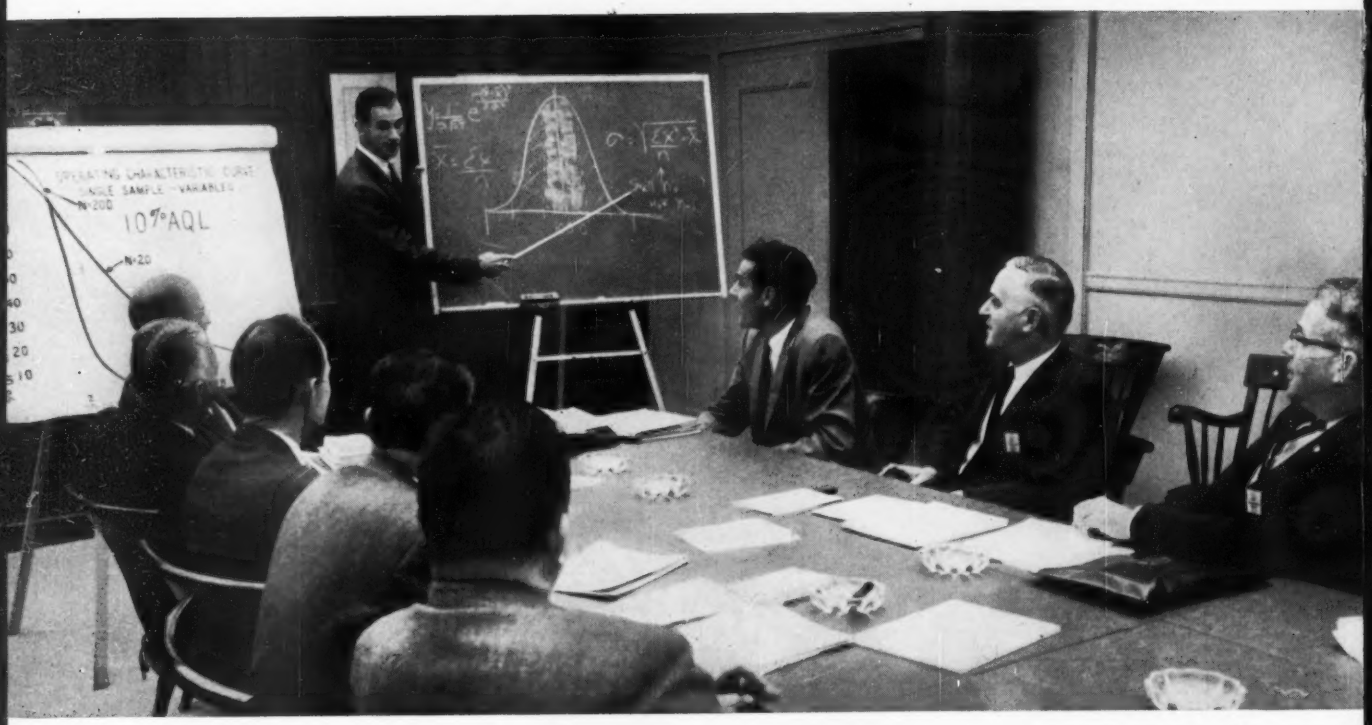


Meter sample testing

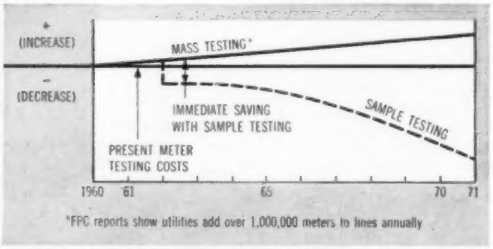
Seminars point up $70 million possible annual saving

The electric utility industry can save an estimated $70,000,000 annually in testing costs by 1971 through universal use of meter sample testing. Twenty-one utilities have already substantially reduced the cost of testing in-service meters by this method whose validity has been thoroughly established and recognized by many utility regulatory commissions; fourteen more are known to be studying its application to their own systems.

General Electric, which has employed statistical sample testing techniques for 10 years in the manufacture of precision watthour and demand meters, shares its accumulated knowledge with electric utilities by conducting sample testing seminars at Somersworth, N. H. Representatives from 62 utilities have attended during the past three years.

Savings to be obtained through sample testing of in-service meters can be added to savings already realized by elimination of the testing of each meter "as received." The latter savings are the outcome of General Electric's proved ability, over the past 10 years, to provide its customers with meters of uniform, certified accuracy.

For information on techniques of sample testing as applied to meters, and how their use can benefit your utility, contact your G-E Sales Engineer or write to General Electric Co., Somersworth, N. H. 604-14



FIRST-YEAR AND CONTINUOUS SAVINGS result from sample testing. Savings will increase as older meters are replaced by General Electric magnetic-suspension meters, which also provide increased revenue through improved meter accuracy.

GENERAL ELECTRIC

Published for 87 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Electrical World

MARCH 20, 196

Vol. 155, No. 12

Electrical What in the World . . .

The most frequent question that comes to us in our conversations with utility men around this country these days is "What is happening in Washington?"

The brief answer to that one is "plenty!" The "Dateline" column on page five of this issue takes you behind the scenes of the Interior Department to give you a brief glance at what is happening there. A story in this week's news section gives you the latest news from the hearings on the US-Canadian treaty for further power development on the Columbia River. In every issue for months we have been doing our level best to keep readers informed of the developing policies and programs of the "New Frontier" Administration.

To do this job we are depending heavily on the 24-man McGraw-Hill Washington News Bureau and especially our correspondent, Burkey Musselman. Covering the fast-moving events and planning of a new Administration gets to be pretty rigorous—as the "Dateline" column this week suggests. But this is all a part of the job for our Washington men.

Their stories have been coming fast and furious and our problem these days is to select the material that will be of most direct application to the utility industry. As you may have noticed, we have leaned heavily on interpretative and background pieces. We think that it is as important to keep our readers up-to-date on policies in the making as it is to tell them of the policies already announced. Conscientious coverage of the Washington scene has long been a staple item in *Electrical World*, but in a year like this, it takes on a more pressing significance.

Chuck Hochgesang

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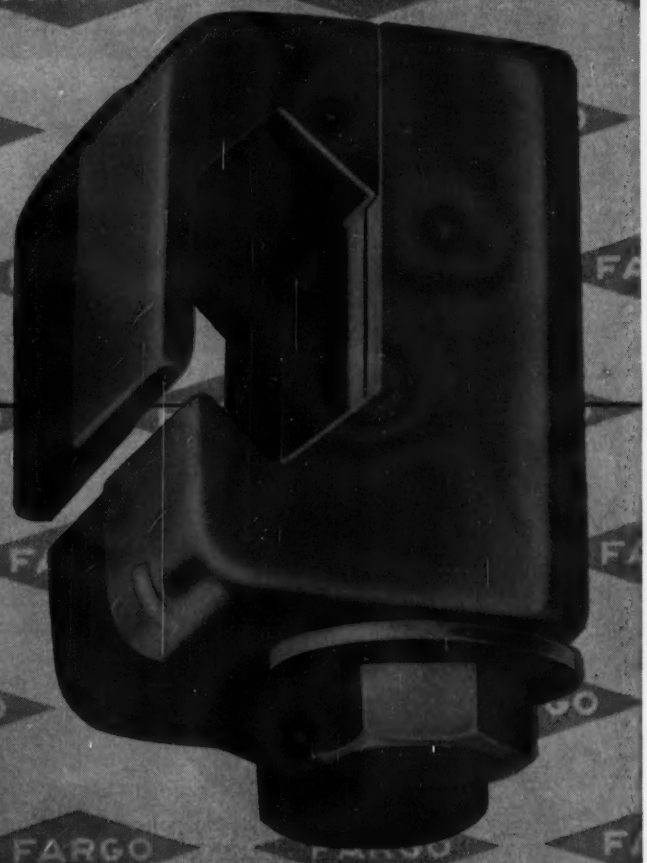

For over thirty years the manufacturing and engineering skill of Fargo has been devoted to producing the finest in "5000 Series vise-type" connectors. From the specially drawn high strength bolt to the custom produced castings Fargo "know how" gives you the very best.

The selection of a flat washer of the proper hardness assures that more tightening torque is converted into clamping force on the conductor rather than dissipated in overcoming artificial friction barriers. These high pressures coupled with the full interlocking of the body make a vibration proof bind from inside thrust against the vise type sleeve of the body. The widest contact areas and the "V" groove assure better encirclement and perfect conductor alignment.

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A complete range of sizes from #6 to #1000 MCM is available only from Fargo.

At Fargo the details count up to the finest in quality and performance.

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Letters

Seeks Clarification

To the Editor:

"Transformers Need Re-Evaluation" (EW, Feb. 6, p 54) gives some very valuable information. However, I should like to raise several points . . . Many papers (have) defined "load factor" as the average load and "loss factor" as the average transformer loss. Actually, the "load factor" is the average load divided by the peak loss. Are the values of "load factor" and "loss factor" as given in Chart 2 on this latter definition?

If so, the relation between "load factor" and "loss factor" can be estimated. Taking those (ten) companies which only reported "load factor" . . . "load factor" varied from 0.45 to 0.63 with an average of 0.494. "Loss factor" varied from 0.28 to 0.45 with an average of 0.321.

Thus "load factor" becomes 1.62 root of "loss factor." Past estimates varied from 1.6 to 2.

In my opinion, transformer performance should be based on average copper loss from peak load at installation to peak load at relief. ("Costs or Losses?" EW, Jan. 6, 1958.)

. . . If peak load is initially 85% of rating and 1.70% at relief with a "loss factor" of 0.321, average copper loss would be 1.7 squared (minus 0.85 squared) divided by 1.386, or 1.562 times 0.321, making average copper loss 50.2% of rated copper loss of transformer when peak load increases from 85 to 170% of rating.

I assume "LF" on page 56 is "loss factor."

J. B. Hodtum, Pittsburgh, Pa.

▶ Our questionnaire did not define "load factor" and "loss factor," but we assume that replies plotted in Chart 2 were average load divided by annual peak, for load factor, and average (load)^2 divided by (annual peak load)^2 for "loss factor." This relationship can be estimated, of course, and reported values for loss factor imply that this was done.

By "average copper loss 50.2% of rated copper loss" we assume you do not mean copper loss at nameplate rating, but at 170% of nameplate on peak.

"LF" on page 56 was intended to be "load factor" as used in analyzing utility rates. Thus, where this load is actually transformer copper loss, load factor to the system would coincide with loss factor of the transformer.

Dateline . . .

Washington, D. C.—To the top appointees at the Interior Department, the "New Frontier" is more than a campaign slogan. It is apparent in their work habits, in their thinking, and in their planning that for them the "New Frontier" is becoming a way of life.

The lights have been burning late on the sixth floor of the Interior Building where the top offices are located. A number of the sub-cabinet officers have been putting in 13 and 14-hr days since they set their brief cases down in the Interior offices. Look in on a Friday afternoon and you can see some bleary eyes caused by the fast pace.

Oldtimers in the Department will tell you they have never seen anything like it. Secretary Stewart Udall calls conferences on five-minutes' notice, sends his aides back to their offices with a new sheaf of directives to be written. Aides fondly describe Udall as "that dynamo in the front office."

The immediate objectives of the Interior Secretary seem to be twofold: **(1)** To instill the enthusiasm and fervor of the "New Frontier" in the older employees, and **(2)** To get moving on anti-recession measures.

Moves to reach the first objective have come in several ways. There is this quote from a mid-February memorandum to all Interior staffs: "The Department . . . is committed to the full development and maximum utilization of the natural resources of the country. I am confident that we will have the energetic support of employees of the Department in furthering these objectives. . . ."

At the second level down, there is this remark by the new Bonneville Power Administrator: "Starting now, Bonneville Power Administration will put into operation President Kennedy's program of 'New Frontiers for America.' Under leadership of

(*Continued on page* 57)

ELECTRICAL WORLD
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Stellite coated exhaust valves and valve seats. One of toughest alloys known. Gives you up to 300% longer valve life than uncoated valves. It's the important details like this that make Onan more economical in the long run.

Exacting standards govern manufacture—years of specialized experience and extensive testing facilities control the quality of Onan Power Plants. Over 1000 different types and sizes of plants are produced by Onan.

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Onan electric plant still delivers full power after 12,197 hour test—equal to 487,888 miles

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Buy *proven performance* when you buy an Electric Plant. See your authorized Onan distributor or dealer. You can depend on him for a lifetime of factory parts and service. He's listed in the Yellow Pages.

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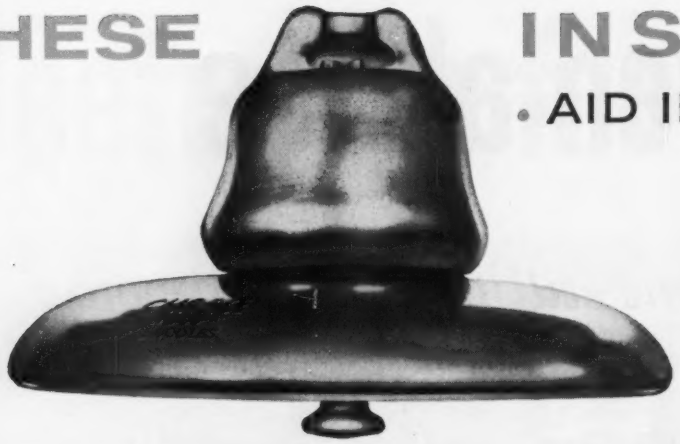
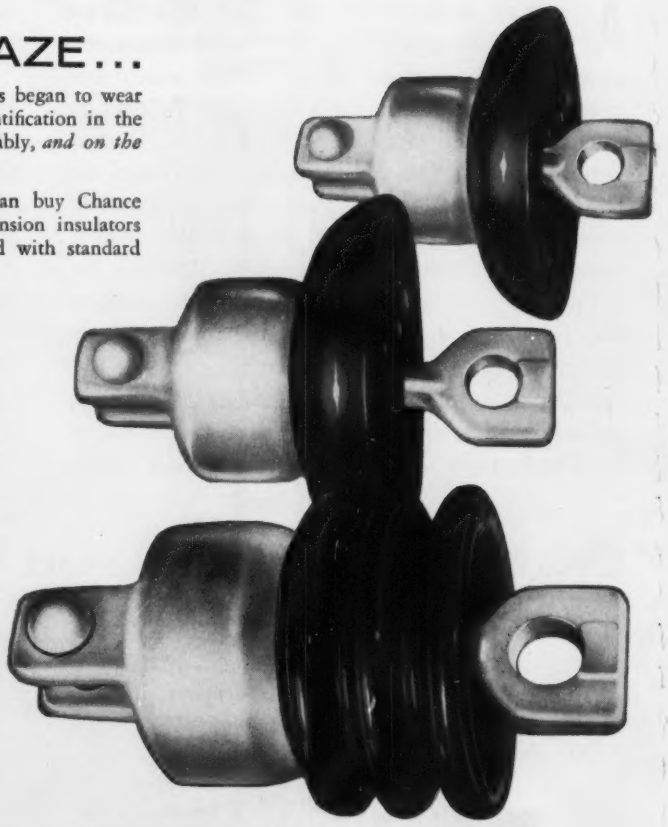


1959 GRAY GLAZE...

Chance 25,000 pound suspension insulators began to wear the new NEMA Gray Glaze for easy identification in the warehouse, on the line truck, in field assembly, *and on the line.*

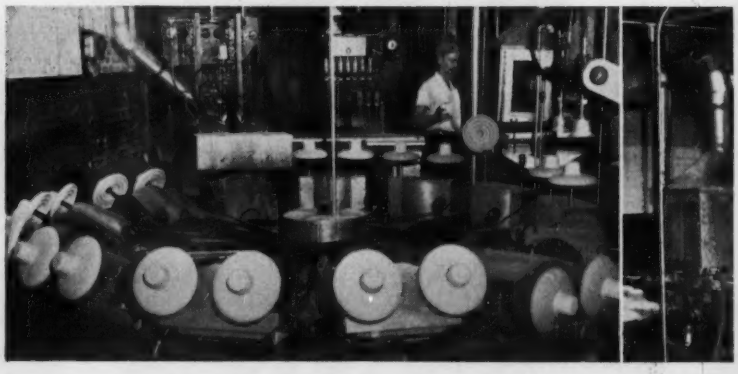
With strength identified by color, you can buy Chance 25,000 pound ball and socket type suspension insulators and be sure they will not be intercoupled with standard 15,000 pound brown insulators.



1960 ALUMINUM Cap and Stud for DISTRIBUTION...

In '60... distribution deadend insulators with forged aluminum caps and studs. The first insulators with corrosion-resistant all-aluminum hardware that makes them as much as 30% lighter than standard insulators. Because they are lighter, they're easier to handle and install. And, because the aluminum hardware is highly resistant to corrosion, they have a longer service life.

WATCH FOR MORE TO COME FROM THE NEW AUTOMATED CHANCE INSULATOR PRODUCTION LINE



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• REDUCE WEIGHT • RESIST CORROSION
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1961 ALUMINUM Cap and Stud for TRANSMISSION

The latest contribution to insulator progress—10-inch extra high voltage suspension insulators with aluminum caps and studs will be rolling off our modern, automated insulator production lines early in 1961.

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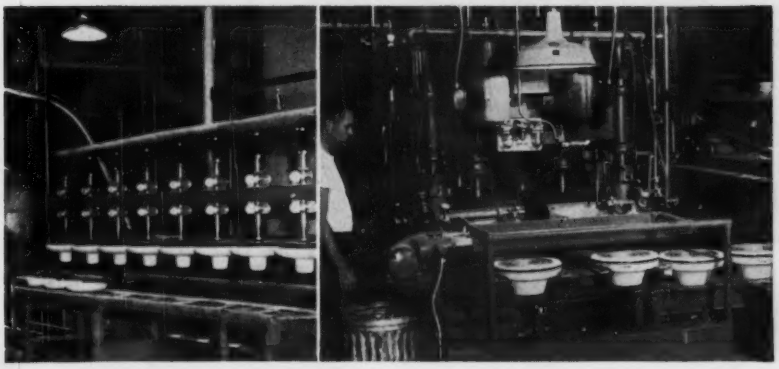
Longer service life in highly corrosive areas—The aluminum hardware is highly resistant to all atmospheric and industrial corrosion. Tests prove you will be able to use these insulators in any location.



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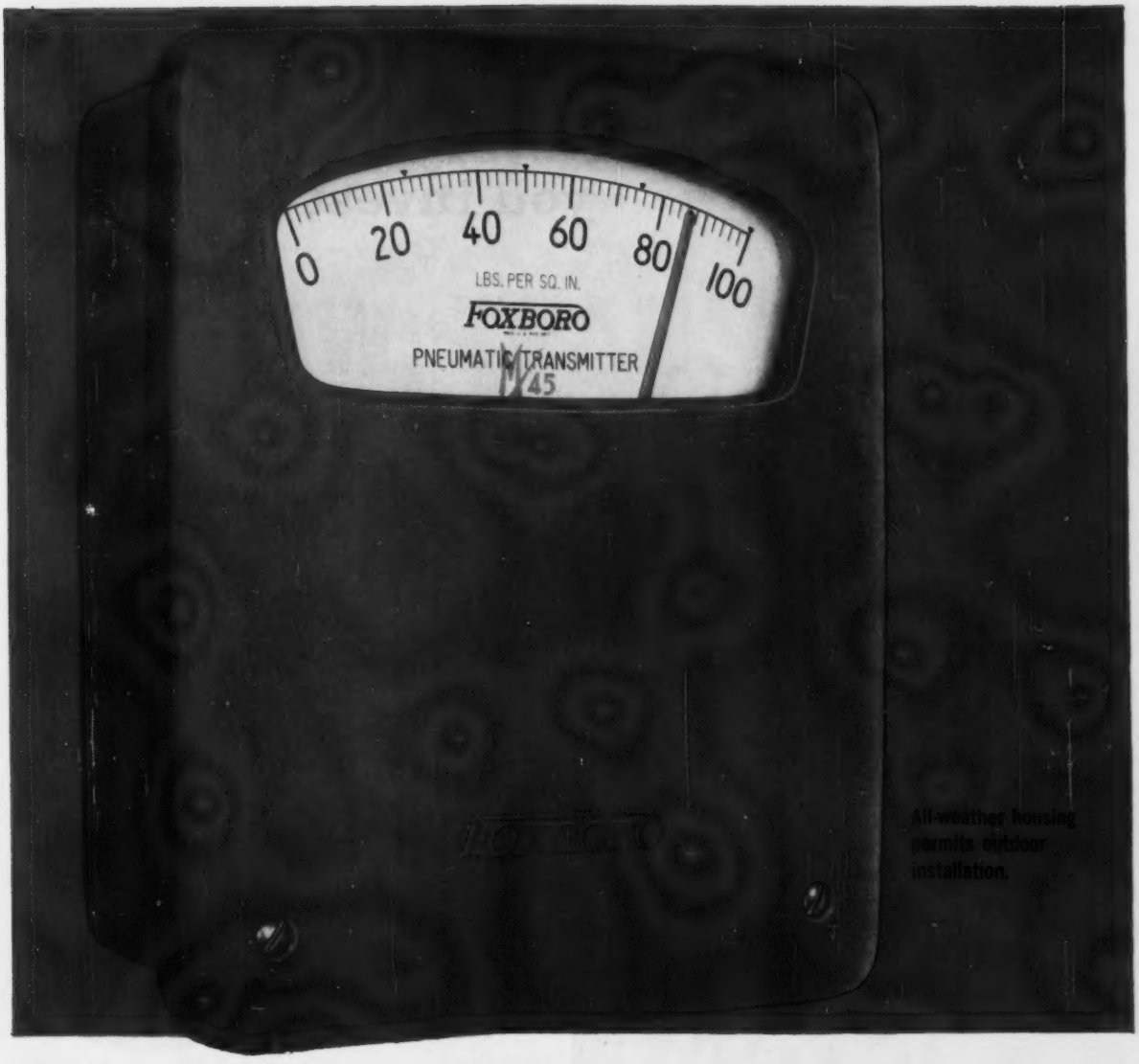

All-weather housing permits outdoor installation.

You can use this new Foxboro pneumatic transmitter on six different process measurements

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Think of it . . . a universal pneumatic transmitter with matched elements for six different process variables. That's the new Foxboro M/45 pneumatic indicating transmitter.

And with the M/45 you get: *universal* high accuracy-guaranteed at ±½ of 1%; *universal* ambient temperature stability — less than ½ of 1% in 50°F temperature change; *universal* calibration and simplicity of servicing. A remarkable combination of versatility and uniformity in a single instrument.

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A porcelain-like coating gives improved corrosion resistance to tank covers, protects from line to ground, insulates small animals from the grounded cover to prevent outages. Applied to the covers, clamping ring and cover bolts, it is available without extra cost on all transformers with cover mounted bushings.

LONG LASTING TANK FINISH

A new formula anti-corrosive paint, carefully applied and thoroughly cured, provides a "Sure Seal" finish that withstands all temperature changes—is much longer lasting in corrosive atmospheres.

SAFETY KEYED BUSHINGS

Heavy wet-process porcelain high voltage bushings are safety-keyed. All terminals are key-locked in the tank wall. Hand tightening terminals are easily hooked up without tools. All bushings are suitable for use with either aluminum or copper conductor.

ROLLED-UNDER BASES

This new base design provides extra strength . . . better moisture drainage. Serves as an additional safeguard against leakage of oil from the tank. It lessens the chance for finish damage due to scraping.

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WAGNER® HIGH CAPABILITY TRANSFORMER
112% NAMEPLATE KVA 65°C. HOT SPOT RISE

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Prize investment, these Wagner® Hi-Thermal-Cap Transformers. Wise buys in High Capability Distribution Transformers that pay off in one dollar and twelve cents worth of usable kva for every dollar of their cost. Solid performers that you can safely uprate to 112% of their nameplate kva without shortening their normal life expectancy, *and without exceeding the allowable 65°C hot spot temperature rise.*

We've built new, compact coils for these money-savers. They're wound LV-HV-LV around one insulating cylinder, and locked into sections of great mechanical strength by corrugated oil ducts and thermosetting insulation. Short circuit tests using 50 times normal current (twice as much as the industry standard) didn't even faze them.

The HI-THERMAL-CAP element, which combines this improved coil with a wound core of cold-rolled oriented grain steel, has excellent electrical characteristics: low impedance for better voltage regulation; low core and copper loss for economical operation. The result: you get top efficiency *plus* high capability with these transformers.

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HI-THERMAL-CAP TRANSFORMERS are available in singlephase ratings of 167 kva and smaller, 15 KV and below for direct pole mounting. You can get them from factory, branch or distributor stocks now. And you can get complete information from your Wagner Sales Engineer. Check with him, or write us.

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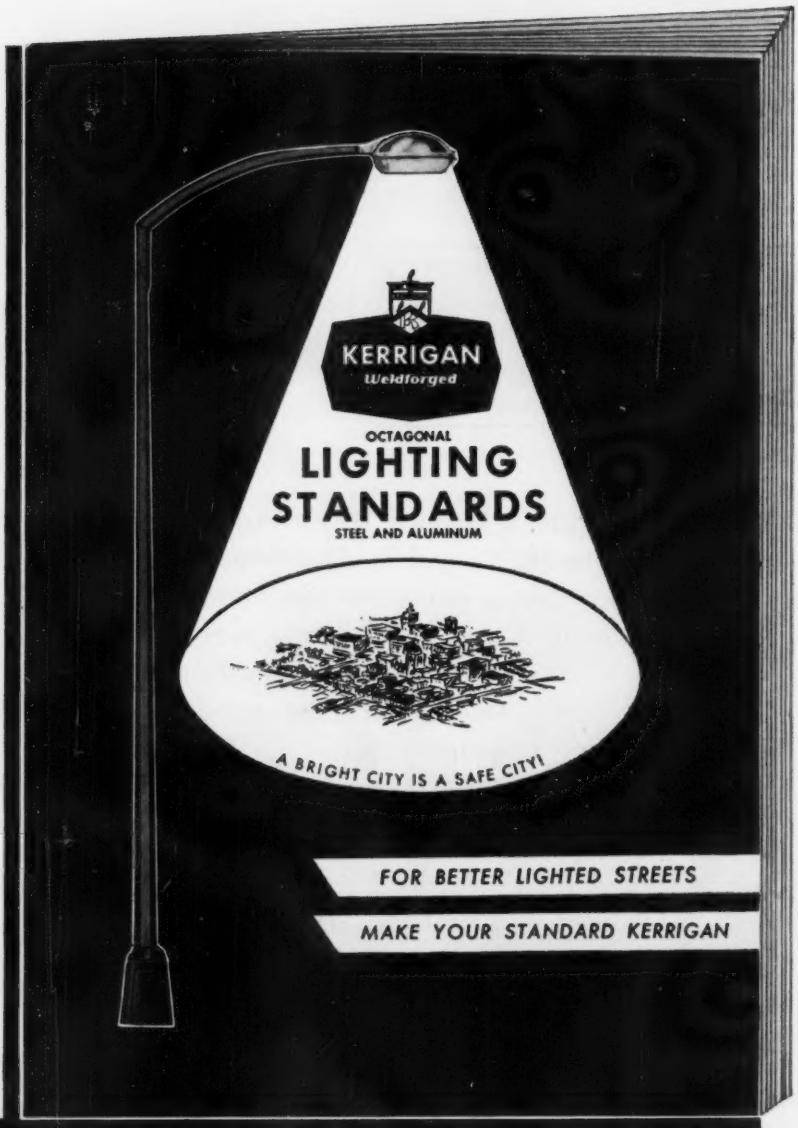

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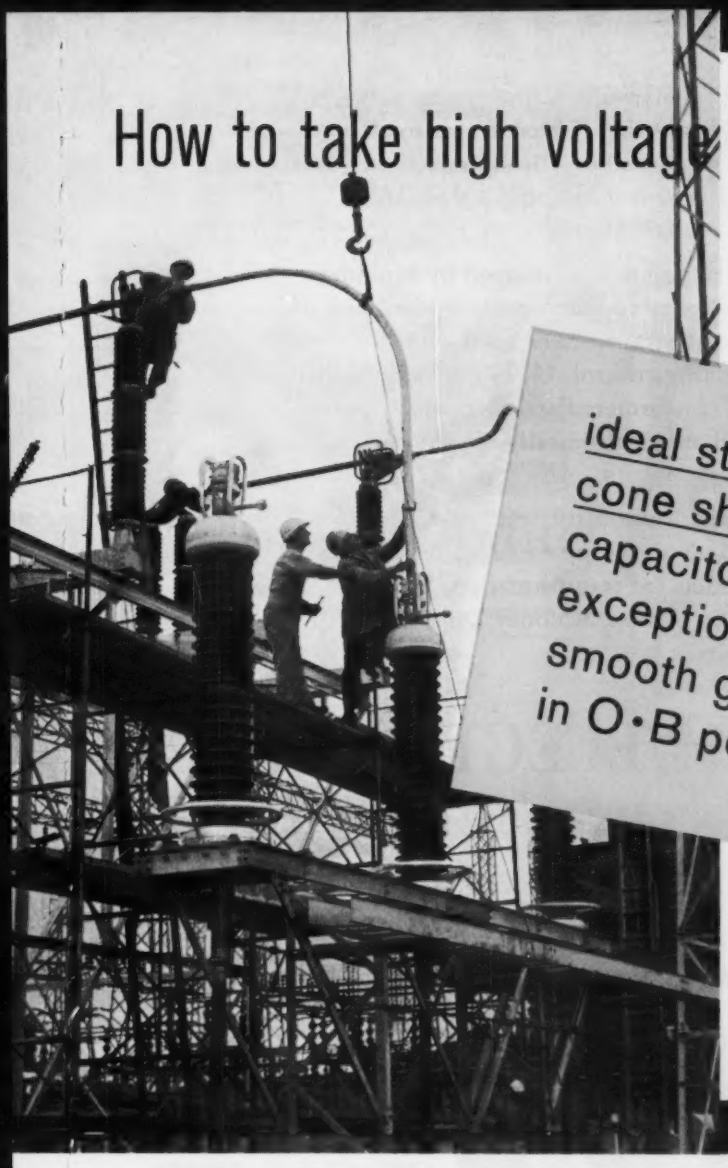
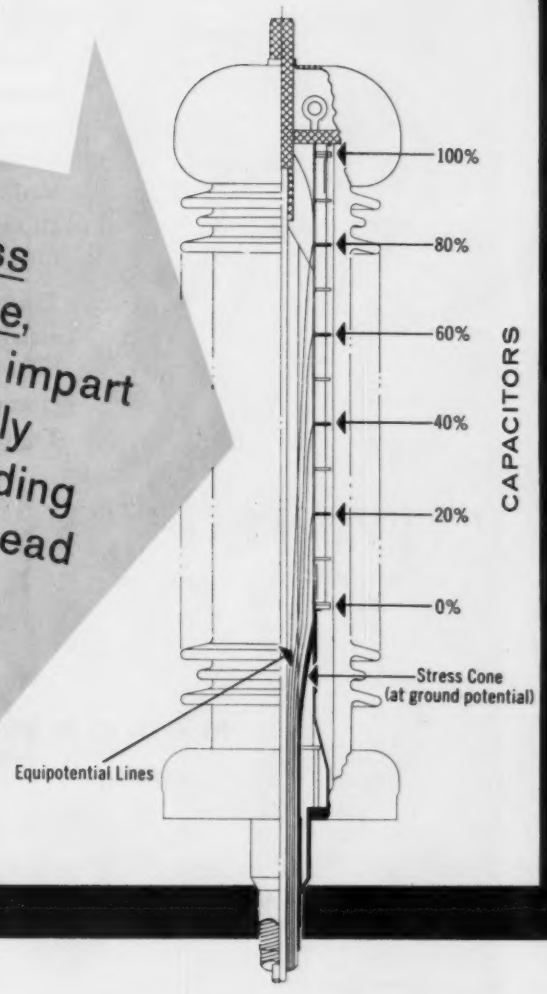


ideal stress cone shape, capacitors impart exceptionally smooth grading in O•B pothead



PROBLEM: To grade the electrical stresses uniformly at the shielding tape termination of a high voltage underground cable.

SOLUTION: Use a smooth, logarithmically-curved stress cone and grading capacitors.

If you were to end abruptly the shielding tapes of an underground cable, you would introduce high longitudinal stresses (parallel to the axis of the cable). In order to relieve these high, localized stresses, ground potential surface must be flared out smoothly.

Flare of this stress cone has been carefully calculated* to keep longitudinal stresses at a uniform and acceptable level. Field shaping of the cone has always left much to be desired. But, O-B's machine-produced, ideally-shaped stress cone is built right into the build-up roll which can be accurately installed, after shielding tapes are terminated, in a matter of minutes.

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For your underground cable systems 115 kv or above, check O-B's capacitor-graded pothead. We'll be glad to furnish you the details.

**Formula for calculating shape of stress cone in AIEE paper CP 60-356 available on request.*

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ME61-6

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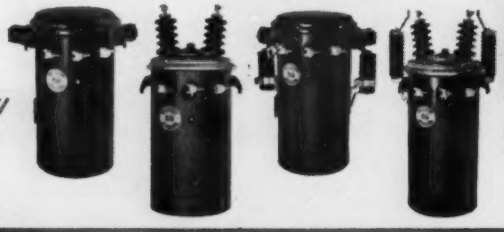
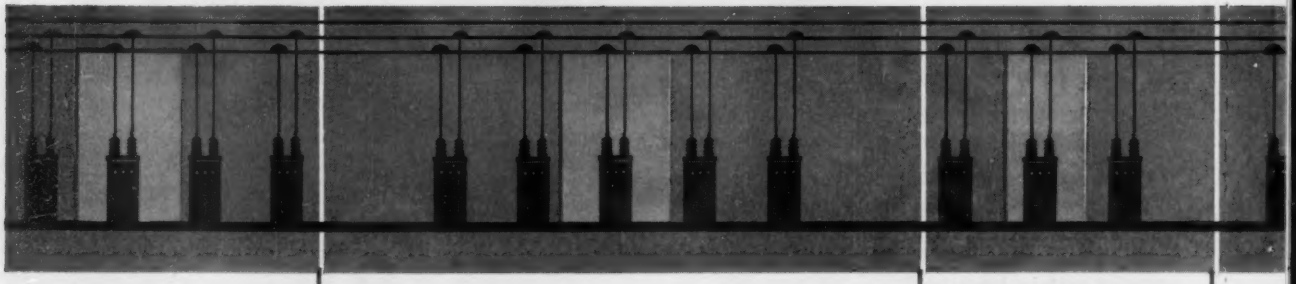
MOLONEY ELECTRIC COMPANY

Since 1896... MORE POWER TO YOU



ST. LOUIS 20, MO., AND TORONTO, ONT., CANADA

*U. S. PATENT NO. 2905891



RATIO TEST

Supplements complete ratio test given each core-and-coil unit before tanking, checks each transformer for correct voltage ratio and ratio adjuster position.

IMPULSE TEST

Proves each transformer capable of withstanding over-voltages resulting from lightning and switching surges by overstressing bushings, layer, turn and divisional insulation as well as insulation between high and low voltage windings, and between the windings and ground.

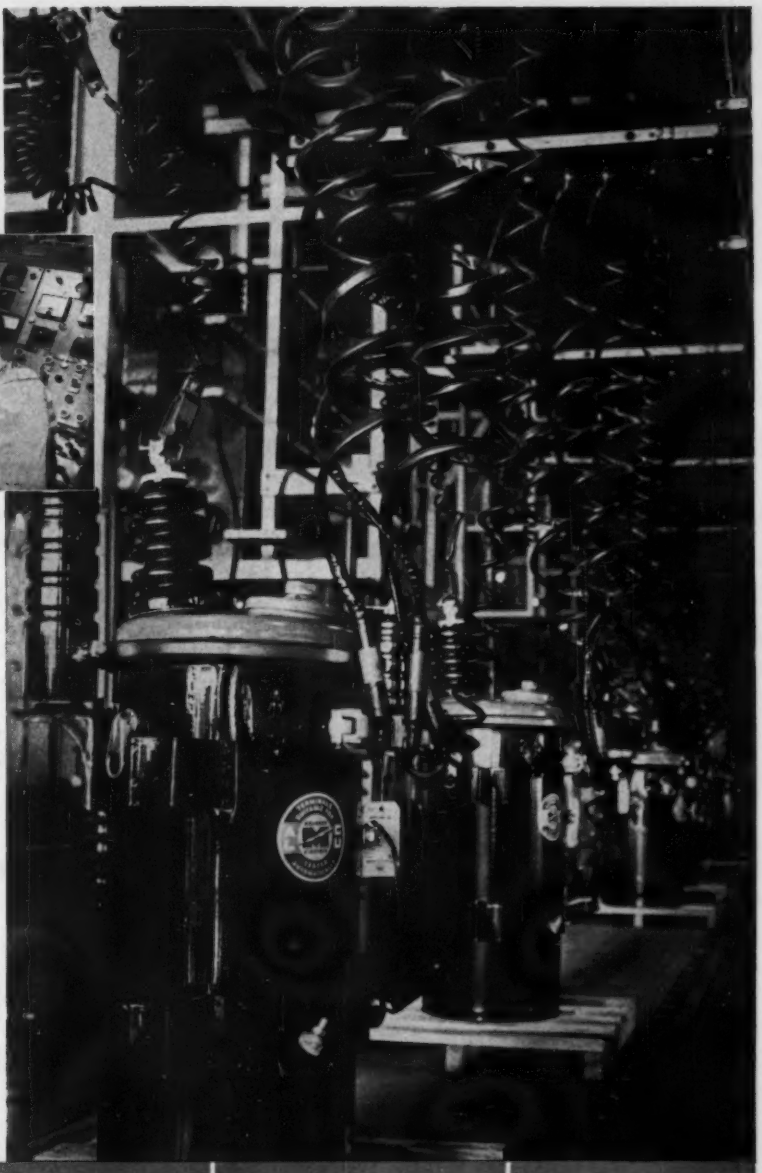
INDUCED POTENTIAL TEST

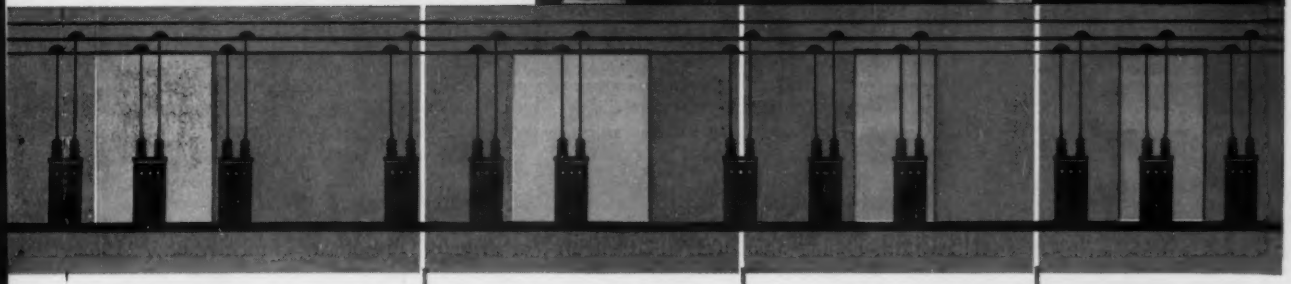
Proves turn, layer and divisional insulation quality of high and low voltage windings.

TEST SYSTEM—After completion of all assembly operations, a moving belt conveyor transports transformers through the automatic test system. Leads connecting the transformers to overhead dollies are attached before the transformers enter the test area. Power for each test is supplied...automatically ...by overhead bus at each test station.

CONTROL ROOM—Central control room houses all test station controls, test metering and recording equipment, and electronic rejection circuits.

TRANSFORMERS





APPLIED POTENTIAL TEST

A low-frequency, high-voltage test of insulation quality between high and low voltage windings, and between windings and ground.

CORE LOSS AND EXCITING CURRENT TEST

Equipment automatically measures the core loss and exciting current of each transformer.

SOUND TEST

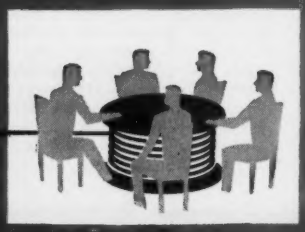
The audible sound level of every transformer is measured while the unit has normal excitation voltage applied.

CSP BREAKER TEST

When applicable signal light and breaker operation is checked under overload conditions for proper operation.

DU PONT

WIRE AND CABLE ROUND TABLE



You have asked...

Q. How is polyethylene tested for thermal stress cracking? And is there a standard test?

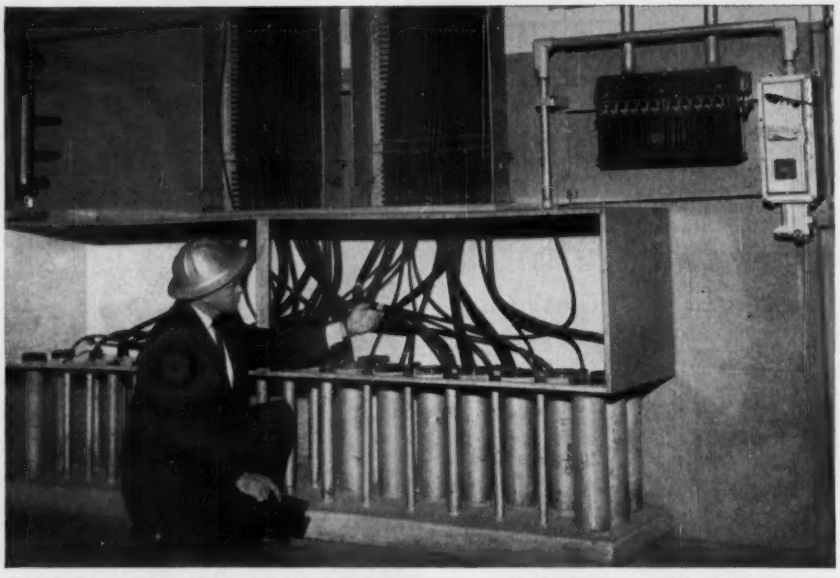
A. There are a number of tests for investigating thermal stress cracking (cracking which appears as a result of high-temperature exposure combined with mechanical stress in the material when neither temperature or stress alone would cause cracking). One of the tests involves wrapping an insulated wire around its own diameter and placing it in an oven at various temperatures. Then the length of time required for cracks to appear is noted.

If the resin is susceptible to oxidation, a nitrogen or other inert atmosphere must be used. When comparisons are to be made, it is necessary to take into account the size and type of the sample, its previous history, the test equipment and conditions, including the type of atmosphere. Users of wire and cable usually need not concern themselves with thermal stress cracking because, as a rule, no resin manufacturer will offer, and no wire manufacturer will use, resins that are in the least prone to thermal stress crack or to oxidative embrittlement.

Field failures from this problem should be unknown, since the suitability of a PE is usually determined long before the material appears on wire. Nevertheless, thermal stress cracking should not be disregarded, particularly if a user or manufacturer is contemplating some sort of new or exotic resin. Resin selection always should be made on a basis of clearly defined end-use properties.

Du Pont does not manufacture wire and cable, but supplies thermoplastic resins to the wire and cable industry.

POLYCHEMICALS DEPARTMENT



The dramatic space savings made possible through the use of control cables protected with Du Pont ALATHON polyethylene resin and ZYTEL nylon resin are shown in the illustration above. The newer cables (above) in the tray distribution system are connected to an older conduit system (below), which requires considerably more space.

Dramatic space savings possible with control cables using ALATHON® and ZYTEL®

Depending upon the number and size of the conductors, control cables using ALATHON and ZYTEL can save 20% to 35% in thickness over the elastomeric constructions in the same class. Thus many more conductors can be installed in existing conduits, or additional space can be saved through the use of economical tray distribution networks.

The superior insulating qualities of ALATHON permit a thinner insulation of .015" to .030". As a secondary insulation, a .004" to .006" skin of ZYTEL imparts exceptional abrasion resistance. Wear from flexing at contact points, and failures due to rough handling at termination points are virtually eliminated.

A high molecular weight jacket of ALATHON withstands weathering, environmental stresses, corrosive elements, and abrasion. It allows miles of cables to be pulled through serpentine tray networks without fear of "skin-back" or other physical faults, and where extreme mechanical abuse or chemical attack pose a problem, an outer armor of ZYTEL insures reliable service.

You may find that the use of ALATHON and ZYTEL will give *you* increased reliability at lower cost. Find out how by consulting your wire and cable supplier, or write for Du Pont's technical bulletin, "Signal and Control Cable Design." Address: E. I. du Pont de Nemours & Co. (Inc.), Dept. EW-3, Rm. 2507A, Nemours Building, Wilmington 98, Delaware.
In Canada: Du Pont of Canada Limited, P. O. Box 660, Montreal, Quebec.

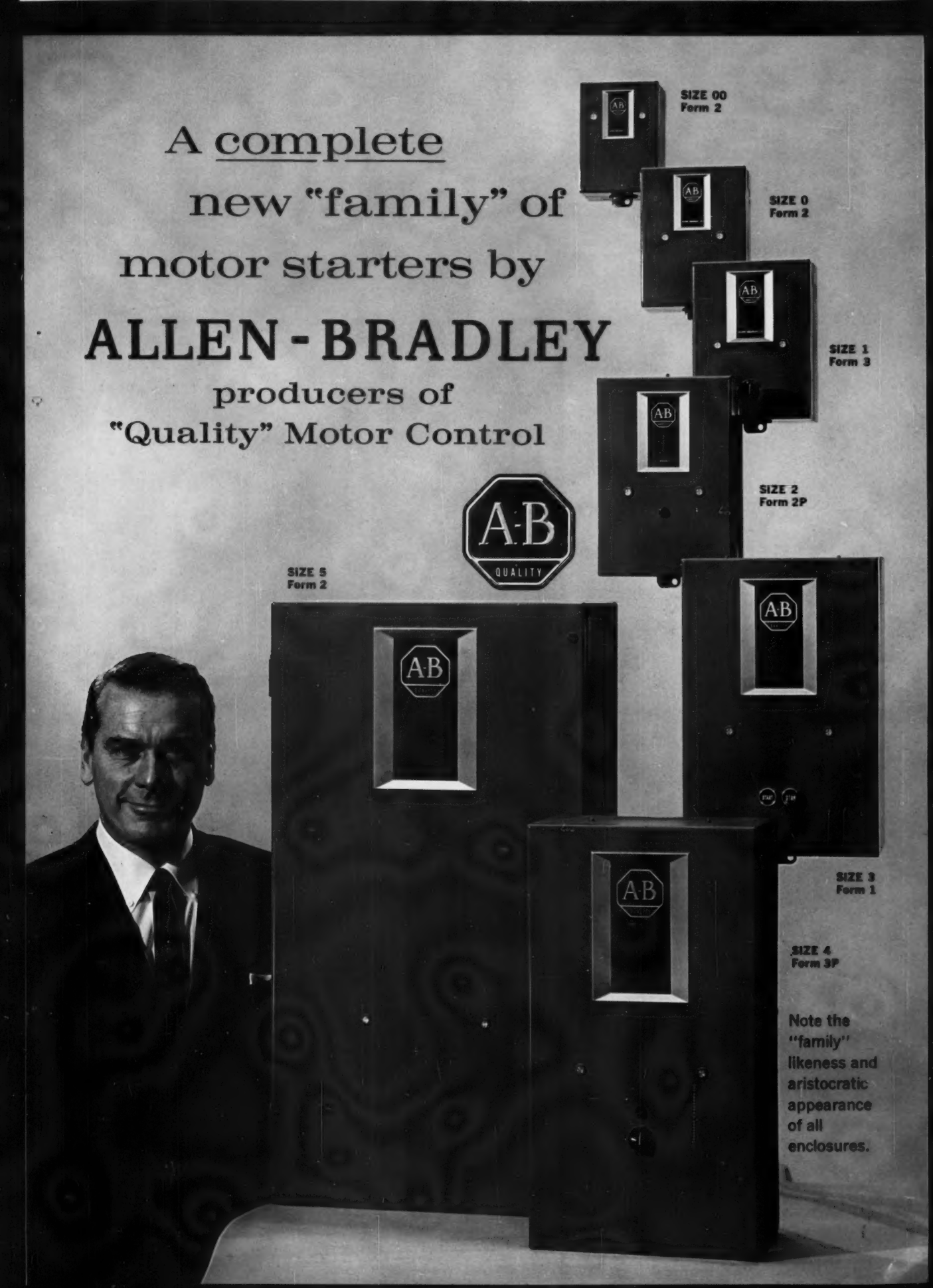
DU PONT
REG. U.S. PAT. OFF.
Better Things for Better Living... *through Chemistry*

ALATHON® POLYETHYLENE RESINS | **RULAN®** FLAME-RETARDANT PLASTICS | **ZYTEL®** NYLON RESINS

A complete new "family" of motor starters by

ALLEN-BRADLEY

producers of "Quality" Motor Control



Greatest advance in motor

PLUS VALUES OF THESE NEW STARTERS

- smaller size
- greater interrupting capacity
- even more millions of trouble free operations
- more wiring room
- elegant styling
- A-B "quality" throughout

Thirty years of experience have gone into the design of this new Allen-Bradley line of motor starters. While retaining the principle of the simple solenoid design—with only ONE moving part—everything about these Bulletin 709 starters is **new**.

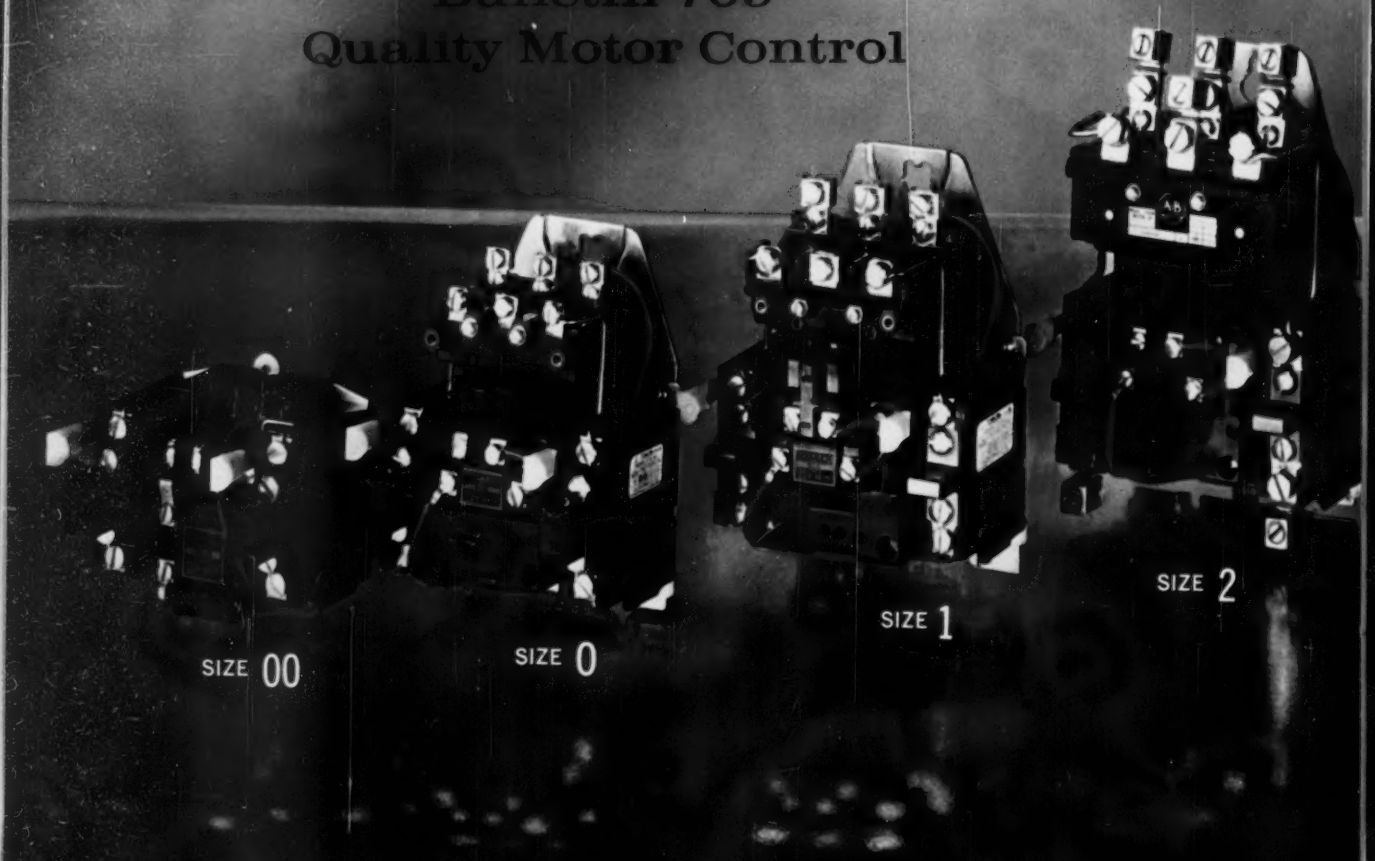
They're small—especially in the higher ratings. Yet, size for size, all tests have proved that they will outlast any starter now on the market—many times.

The **new**, patented, high-efficiency magnet—remarkably powerful for its weight and size—is cushioned to reduce shock and wear. The **new** coil is encapsulated for mechanical protection, and cannot be damaged by any corrosive atmosphere in which it may be used. The **new** precision hot molded arc hood confines the arc and increases the interrupting capacity.

ALLEN-BRADLEY

A-B QUALITY

Bulletin 709
Quality Motor Control



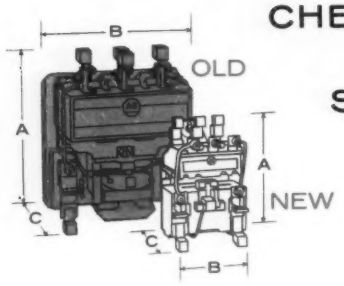
control...in 30 years!

New weld-resistant, cadmium oxide silver contacts close and seat firmly, eliminating the sliding motion that causes wear. The overload relays are also **new** and are not only completely *trip-free* but also *tamperproof*. Of course, they were designed to use the **old** Bulletin 709 heating elements you have in stock.

Brooks Stevens is responsible for the smart cabinet design—a distinct sales asset on any type of installation. Better write today for more information on this *revolutionary* **new** line of Allen-Bradley Bulletin 709 *quality* motor starters.

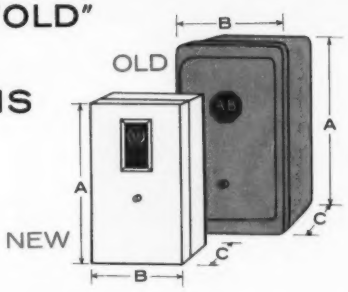
THESE NEW BULLETIN 709 ACROSS-THE-LINE SOLENOID STARTERS ASSURE YOU SUPERIOR PERFORMANCE IN YOUR TOUGHEST MOTOR CONTROL APPLICATIONS.

Note, also, the "family" likeness of all open type starters. Imagine the beautiful "special panel" engineering that can be done with this A-B family of starters, contactors, and relays.



CHECK THE "NEW" WITH THE "OLD" BULLETIN 709 SPACE-SAVING DIMENSIONS

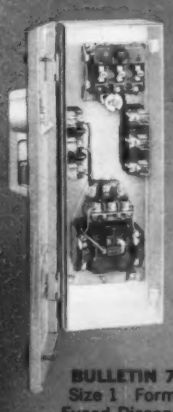
The wiring room in the new enclosure will delight the electrician.



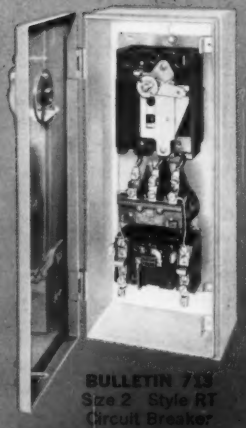
TOTAL OVER-ALL DIMENSIONS

Starter Size	OPEN TYPE STARTERS						NEMA 1 ENCLOSURES					
	NEW			OLD			NEW			OLD		
	Height A	Width B	Depth C	Height A	Width B	Depth C	Height A	Width B	Depth C	Height A	Width B	Depth C
00	3 5/8	3 7/8	3 9/16	—	—	—	7 5/8	4 7/8	4 1/4	—	—	—
0	5 7/8	4 1/16	3 1 1/16	5 5/8	4 3/4	3 1/4	9 1/8	6 5/16	4 3/8	7 7/8	5 5/8	4 1/4
1	6 5/8	4 1/2	3 1 1/16	5 7/8	5	3 1/4	10	6 13/16	4 3/8	8 13/16	6 3/8	4 1/4
2	7 3/4	4 5/8	3 1 1/16	10 1/16	5 3/4	4 7/32	12	7 5/8	4 3/8	14 1/2	9	5 7/16
3	10 1/4	6 1/4	5 7/16	12 5/8	7 1/4	5 7/16	16 5/8	10 3/8	7	19 1/2	11 3/8	6 1 1/16
4	11 7/16	7 5/16	6 1/4	16 1/4	12 3/4	6 1 5/16	22	11 5/8	8	26 9/16	14 3/16	7 1 1/16
5	14 1 3/16	9	6 1/2	20	16 1/8	8 3/4	32 3/16	17 3/16	9 7/8	41 1/2	19 9/16	13 9/16

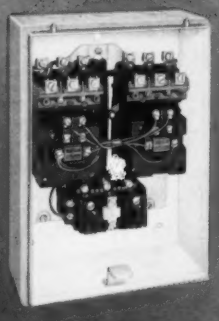
Also...other across-the-line starters in the NEW A-B design!



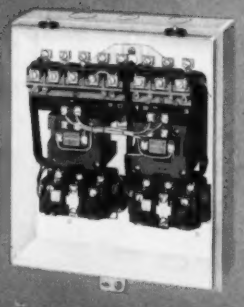
BULLETIN 712
Size 1 Form 2F
Fused Disconnect



BULLETIN 713
Size 2 Style RT
Circuit Breaker



BULLETIN 705
Size 1 Style RT
With Overload Relays



BULLETIN 715
Size 1 Two Speed
Consequent Pole

ALLEN-BRADLEY

Member of NEMA

Quality Motor Control

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wisconsin

A-B QUALITY

9-61-RM

Electrical World

MARCH 20, 1961
Vol. 155, No. 12

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INSULATION AND RADIO INFLUENCE dictate design of 650-kv substation.

The Electrical Week

LATE NEWS ▶ **Interior Secretary Stewart Udall orders Bureau** of Reclamation to start at once on land surveys and design work for $28.8-million worth of federal transmission lines from Trinity hydroelectric project, Calif., to the Bureau's Central Valley Project. The all-federal, 230-kv lines would be built on the recommendations of the Bureau's report to Udall. These recommendations are: **(1)** The lines would be built as "common carriers," open to any system who wanted to use part of their excess capacity. The proposed Bonneville-California intertie would be built as a federal "common carrier" also . . . **(2)** A $320,000 appropriation, already granted by Congress, would be used immediately for surveys and design work on the lines south of Keswick, Calif. . . . **(3)** The Trinity lines between Keswick and Tracy, Calif., built as 230-kv lines, would be designed for future conversion to 500 kv as part of the Bonneville-California intertie . . . **(4)** The Bureau may hire outside engineering consultants, in addition to its own engineers, to speed up construction.

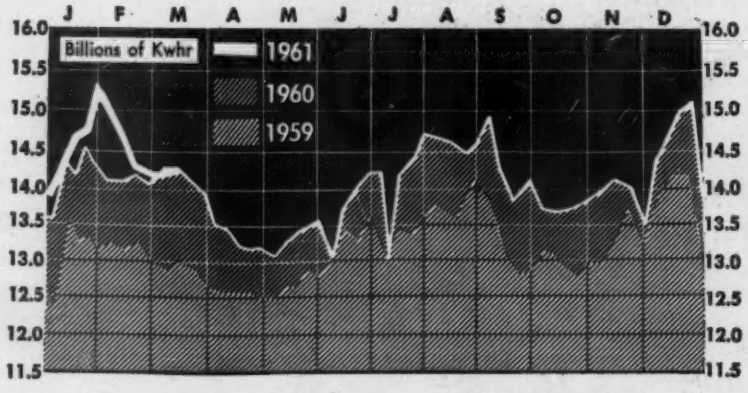
TVA announces uprating of "800-Mw" units to 900 Mw. Actually, guaranteed capability of original units was 865 Mw. In conjunction with closing boiler contract, TVA exercised option to increase unit rating 35 Mw, for extra $1 million each. Pressure and speeds have not been selected yet.

New 580-Mw unit will be added to Indiana & Michigan's 510-Mw Tanner's Creek plant. Heat rate will be about 8,500 Btu per kwhr. Steam conditions will be 3,500 psi with 1,000F initial heat, 1,025 first reheat, and 1,050 second reheat. AEP also announces plans for construction of 186 circuit miles of 345-kv transmission, including lines Tanners Creek and recently announced tie with Indianapolis Power & Light Co.

New magnetohydrodynamic generator produces 205 kw of power, 20 times greater than that achieved in 1959 when utility-sponsored MHD program was launched. Boston Edison and United Illuminating have joined original ten companies sponsoring AVCO's research. Budget for 1961 is tripled to $1.2 million.

Post Office Department orders 300 three-wheeled electric vehicles for city mail delivery. Made by Highway Products, Inc, of Kent, Ohio, the vehicles are expected to cut maintenance costs some 50% and carry 62% more mail than gasoline vehicles now in service. Most of the vehicles will be used in the South. If these units are successful, Department may extend use to other parts of the country.

WEEKLY POWER OUTPUT—Down 0.2% (Week ending Mar. 11), Kwhr 14,353,000,000



Per Cent Change From Previous Year

	Feb. 25	Mar. 4	Mar. 11
Total U. S.....	+ 0.3	— 1.0	— 0.2
New Eng.	+ 4.5	+ 3.6	+ 4.8
Mid. Atlan.....	+ 3.0	+ 1.6	+ 2.3
Cent. Indust...	— 5.9	— 7.1	— 5.8
West Cent.....	+ 2.8	+ 1.1	+ 1.2
Southeast	— 1.7	— 4.0	— 5.8
South Cent....	+ 4.0	+ 2.2	+ 2.4
Rocky Mount...	+10.7	+ 9.1	+12.1
Pacific			
NW	+ 4.0	— 0.9	+ 2.8
SW	+ 6.1	+11.5	+15.7

Seasonally Adjusted Index 278

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Source: Edison Electric Institute

Supply Lines

EIGHTY UTILITIES TO STUDY DAMAGES TOGETHER

Lawyers from 80 investor-owned utilities last week launched studies to determine whether their companies had suffered damages as a result of antitrust violations by electrical manufacturers. But even as the legal group began work, top executives in the companies represented discussed the possibility of setting up a steering committee to guide the studies.

While no precise time schedule was set by the committee of lawyers, some top utility executives expressed the view that the group must act quickly in view of suits already instituted by the government (p 56).

It was made clear that the lawyers committee will act primarily as an information-collecting agency. Each company represented retains its full freedom of action as far as possible damage action is concerned. Edison Electric Institute may be asked to disseminate information about the group to EEI members, even though the legal committee is set up outside the industry association.

Consultants employed by the committee are Stone & Webster Engineering Corp which will analyze prices charged for the equipment; Dr Jerome B. Cohen, Professor of Economics at the City College of New York, who will study prices that would have been charged in the absence of a conspiracy; and Dr Willard L. Thorp, Professor of Economics at Amherst College, who will provide economic guidance.

In another action related to damages, a federal judge dismissed a $750-million suit against General Electric Co. The suit had alleged damage to 50 million GE customers because of GE's pricing policies (EW, Feb. 20, p 16).

SUPPLIER CALLS TIME OUT BECAUSE OF LOW PRICES

Because of the current "give-away prices" for heavy electrical equipment, time out has been called by one of the manufacturers. I-T-E Circuit Breaker Co says it is recasting its business into a "holding operation" until heavy equipment prices rise to reasonable levels. What this means, a spokesman explained, is that for the time being, I-T-E will generally not quote low prices to capture new customers or to win sealed bid business. Rather, the company will concentrate on holding on to old customers, customers with which it does a repeat business.

At the same time, the company will place more emphasis on its lighter lines where it can make a profit. The alternative to the holding operation, the spokesman said, was to cut down on quality and thus cut costs, but this approach was rejected "because we're not going to make junk out of our stuff." In 1960, the company posted a $286,000 loss on $115 million in sales. In 1959, on $118 million in sales, net income was $2.7 million.

NEW PRICES ANNOUNCED ON LARGE POWER, DISTRIBUTION TRANSFORMERS

New published prices for large power transformers went into effect March 15, Allis-Chalmers Manufacturing Co announced last week. The company said that although the new prices will be below previously published ones, they are above today's market level. The reason for this, the company explained, is that present-day costs "require a higher price level in order to bring a satisfactory return on

sales and to permit continuation of supplying quality products." Allis-Chalmers terms the new prices "net values" and says they will allow purchasing agents to predict accurately the cost of transformers for their planning departments.

In another price move, an increase of approximately 2.7% on 15, 37.5, and 75-kva distribution transformers will be made April 1 by the RT&E Corp.

MATERIALS MANAGEMENT WILL BE THEME OF EEI P&S MEETING

"Improving Materials Management Efficiency and Costs" will be the theme of the fourteenth annual meeting of the Edison Electric Institute Purchasing and Stores Committee to be held at the Shamrock-Hilton Hotel in Houston, Texas, May 15-17. Among the topics to be discussed will be automatic purchasing, practical material requirement forecasting, purchasing performance at its best, utilization of local vendors' stocks, and other subjects. Chairman of the meeting will be Robert B. Gear of the Commonwealth Edison Co.

TVA SAYS IT IS STILL RECEIVING IDENTICAL BIDS

The Tennessee Valley Authority has announced it is still receiving identical bids. Last week, the item specified was condenser tubing, on which six identical bids were received. But TVA awarded a $313,277 contract to the Wolverine tube division of Calumet & Hecla, Inc, because its bid was well below the identical ones as well as below two other domestic and three foreign bids. Two weeks ago, TVA announced it had recently been receiving identical bids on cement, ACSR cable, lightning arresters, oil circuit breakers, suspension and bus-type insulators, current and potential transformers, distribution transformers, and over-current ground relays.

INCREASED COMPETITION EXPECTED IN RESIDUAL OIL

Increased competition, and possibly lower prices, on residual fuel oil are predicted as the result of a new government ruling on residual oil imports. The prediction comes from the coal industry which fears that the liberalized import provisions will soon oust coal from present East Coast markets.

The government ruling will in effect increase by about 50% the number of companies importing the fuel. In addition, the quota for the year starting in April will be about 9% above what was estimated to be used in 1960. And the government says the amount of residual fuel oil to be imported will be enough to make up the difference between domestic production and East Coast demand, based on estimates by the Bureau of Mines. Finally, allocations to importers will be made on a yearly, rather than quarterly basis.

Purpose of the ruling, according to the government, was to alter the method of dividing the imports among the importing companies, without altering the relationship of coal to residual fuel in the price-sensitive East Coast electric utility market.

But a spokesman for the coal industry said he anticipates "a series of price-cutting maneuvers in order for new licensees to obtain customers." Another said there would be "a frantic scramble for existing coal markets by oil importers."

L-M SRT TRANSFORMERS are self-contained and require no more pole space than conventional pole type transformers. The electronic control is completely external, permitting field adjustment of band midpoint from 120 to 126 volts.

L-M SRT® Transformers Now Cost Less: You Can Save Up To $55 Per Transformer

Test period now completed proves SRT transformers reliable. Electronic SRT's are now being mass produced for stock shipment at lower price.

Line Material's SRT transformer has entered the final phase of product development. The SRT transformer has been successfully field-tested by most utilities throughout the nation. It has proved more than reliable in every respect.

L-M has had the SRT transformer in full production for some time. Mass production has resulted in short delivery time for our customers, stock shipment in most popular sizes, and lower overall cost for L-M. Line Material now passes along these benefits of mass production through lower costs to you. SRT transformers are priced as a standard tapped transformer with an adder for the SRT components.

Now you can have the benefits of SRT transformers at additional savings up to $55. Ask your L-M Field Engineer how the use of SRT transformers can reduce your distribution costs.

THE SRT TEST PLUG, right, can be used to determine if all components are functioning properly. It also permits operator to place transformer on any tap position desired should there be a reason to remove the automatic control. When the electronic control is removed, the SRT operates as a fixed-ratio transformer.

OUR 50TH YEAR · LM · 1911 — 1961

LINE MATERIAL® Industries

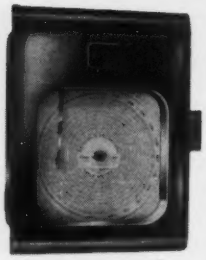
McGRAW-EDISON COMPANY

507

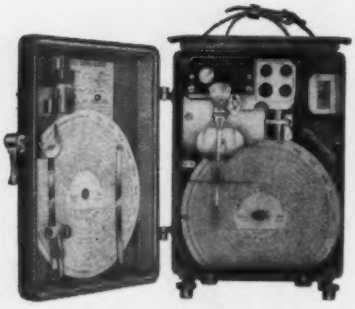
Transformers

McGRAW EDISON

DISTRIBUTION TRANSFORMERS · RECLOSERS, SECTIONALIZERS AND OIL SWITCHES · FUSE CUTOUTS AND FUSE LINKS · LIGHTNING ARRESTERS · POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS · CAPACITORS · REGULATORS · OUTDOOR LIGHTING · LINE CONSTRUCTION MATERIALS · PORCELAIN INSULATORS · FIBRE PIPE & CONDUIT



Bristol Recording Voltmeter for permanent mounting.



Bristol Recording Voltmeter for portable use. Compact Series 631.

Bristol's rugged, moving-iron element:

Key to RECORDING VOLTMETER ACCURACY and RELIABILITY

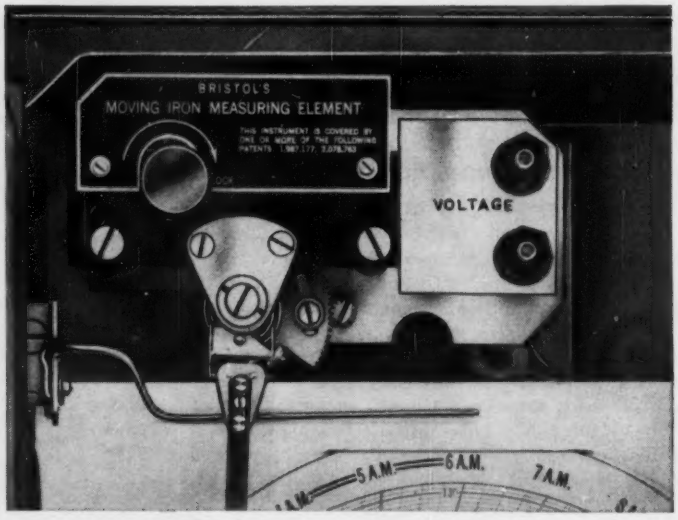
Up to 3 elements, 3 pens, per instrument for recording up to 3 independent voltages on a single chart

Nobody can make a recording voltmeter movement like Bristol... field-proved for year-in and year-out dependability and precision. Check these outstanding features:

- **Thermistor compensated.** Results in negligible temperature error.
- **High Accuracy.** ±1% of full scale.
- **High-Torque.** The Bristol moving iron mechanism produces greatest feasible torque, keeps weight and power drain to a minimum, assures positive recording over full range.
- **Low Electrical Burden.** Only 5.5 VA at 120V for each mechanism.
- **High Calibration Stability.** Seldom requires calibration.
- **Easy Calibration in Field.** No special tools or skills required.
- **Rugged Construction.** Shockproof ball-bearing movements; pen locking device for shipping or carrying portable models.
- **Leveling Not Critical.**
- **ASA Models Available.** Meet Specification C39.2-1953.

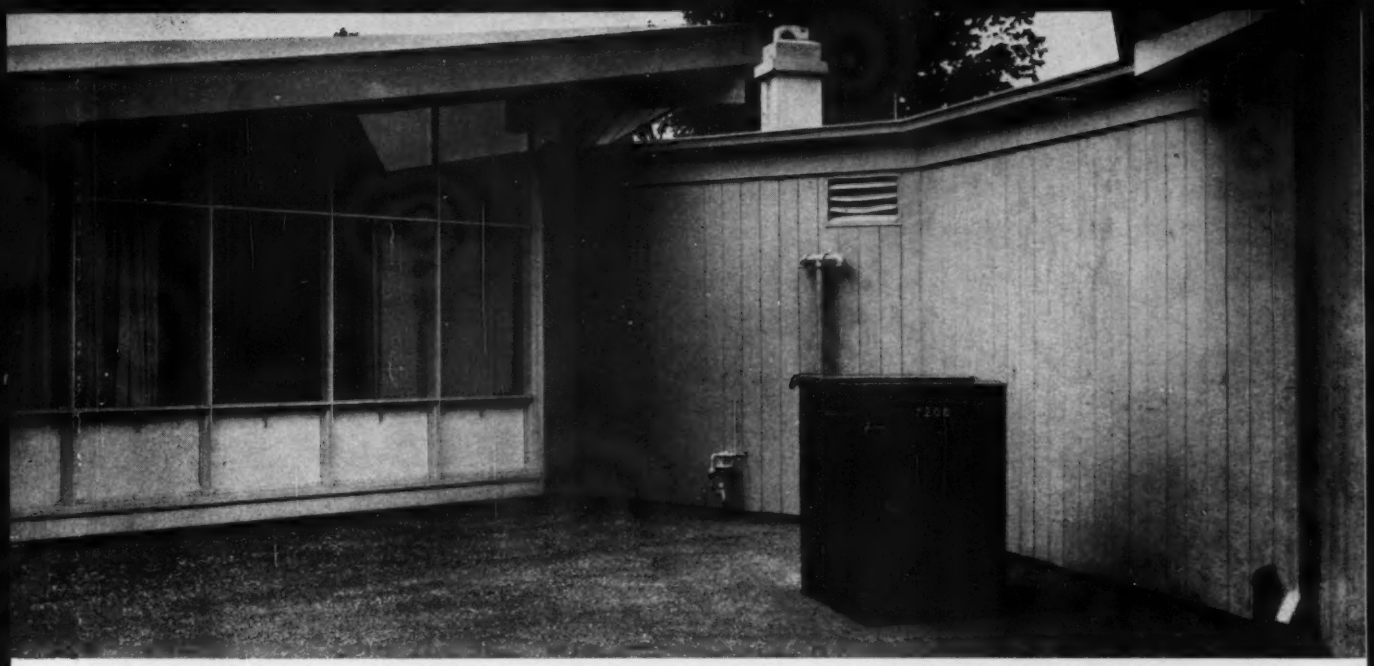
These are just a few of the good reasons it will pay you to standardize on Bristol 1, 2, or 3 pen recording voltmeters. For more facts on Bristol recording voltmeters and ammeters, write for Bulletin E1111.
The Bristol Company, 116 Bristol Road, Waterbury 20, Conn.

O.3



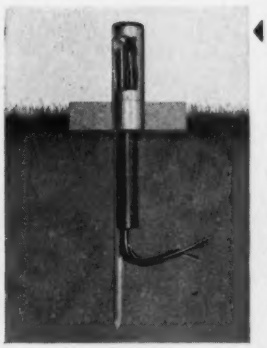
BRISTOL ... for improved production through measurement and control

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS



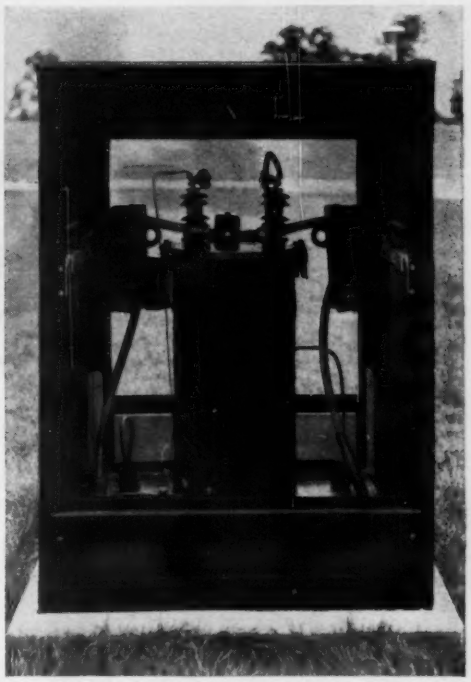
This is the *first* pad-mounted transformer installed anywhere in the United States by anyone. It is L-M's Pad-Mount®, Serial No. 1763851, shipped on March 17, 1958 and energized in June of that year at the Blackhawk School in Roselle, Illinois. Modifications in this original design make the Pad-Mount the most convenient, practical, and economical transformer of this type. In all distribution voltages, in ratings through 167 kva single phase and 500 kva 3-phase.

Wide Choice Of L-M Equipment Designed To Cut Costs Of Underground Distribution



L-M Power Pedestal, an L-M development, provides rainproof, tamperproof facilities for above-ground connection of cables. Several types available.

L-M low-cost Fault Indicator will save many hours of labor and outage time by instantly and visibly indicating the faulted section of cable.



The L-M Transclosure provides a ventilated, weatherproof, tamperproof housing for pole-type transformers, protective equipment, switches, etc. A convenient, economical bridge between overhead and conventional underground. May be ganged if desired. No de-rating of transformers. Note installation of Cable Fault Indicator.

Ask The L-M Field Engineer For Information

As the leader in designing equipment for underground distribution, L-M can provide a wide variety of experience on systems and apparatus. Ask the L-M Field Engineer for Application Bulletins, Test Data, and Product Information; or write Line Material Industries, Milwaukee 1, Wisconsin.

499

LINE MATERIAL® Industries

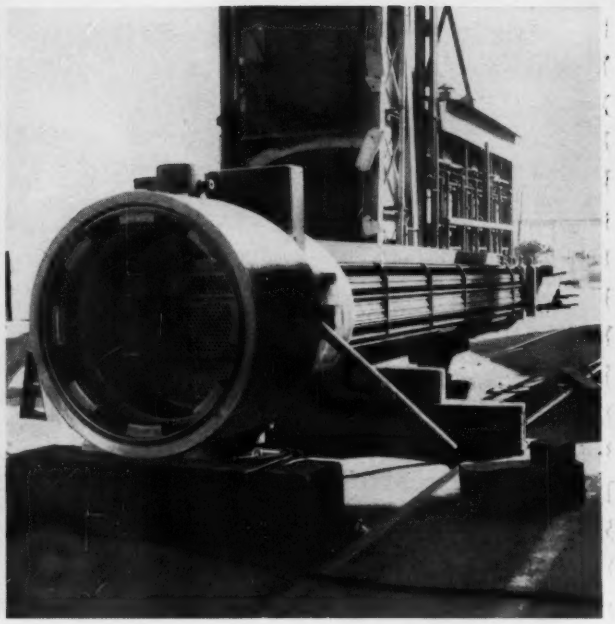
McGRAW-EDISON COMPANY

Underground Distribution Equipment

McGRAW EDISON

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE & CONDUIT

Using special type gun, average operator can make completely tight tube weld in less than 15 seconds.

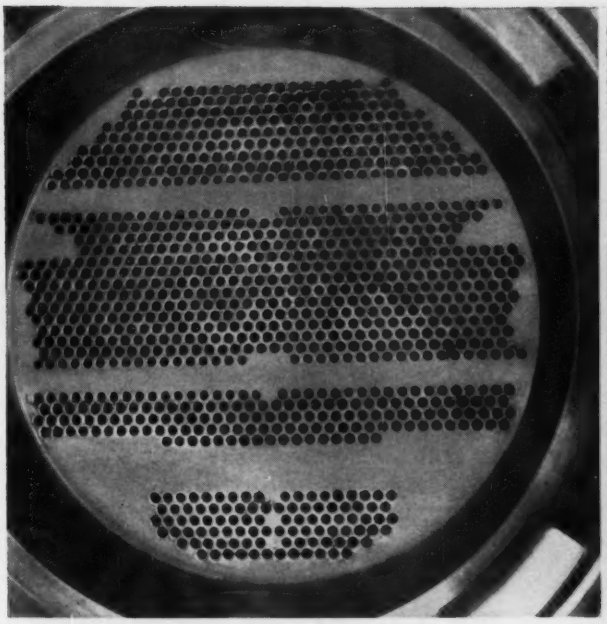


Head-on view of unit. Cufenloy-30 tubes are fabricated by special Phelps Dodge drawing and heat-treating process.

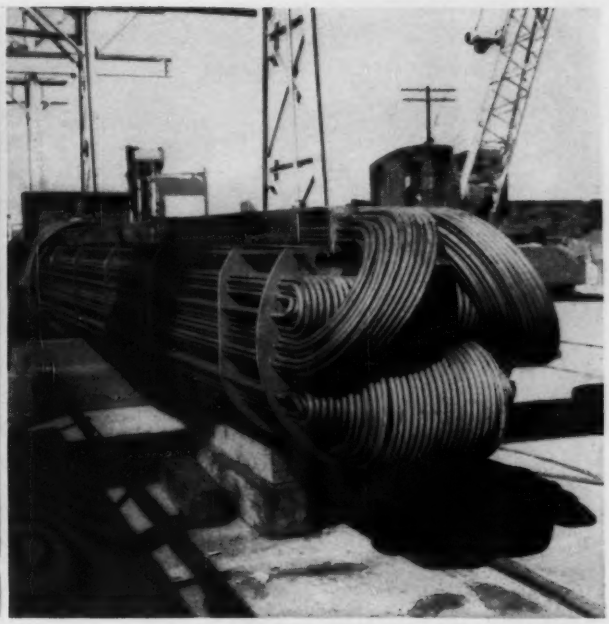
PHELPS DODGE CUFENLOY-30 DUAL GAUGE TUBES WELDED INTO FEEDWATER HEATERS

U-bent units combine new high strength alloy tubes and new tube jointing technique for superior heat transfer efficiency and dependability

Photographs: Courtesy of Southwestern Engineering Co.



Close-up of tube sheet shows welded-in tubes in place. Incomplete or unsound welds are easily corrected by re-welding.



Rear view of high pressure feedwater heater unit shows configuration of Cufenloy-30, U-bent Dual Gauge tubing.

Dual Gauge tubes of Cufenloy-30, the new and weldable, drawn, stress-relieved copper nickel alloy developed by Phelps Dodge, have been welded into high pressure feedwater heaters constructed by Southwestern Engineering Co. for a West Coast utility.

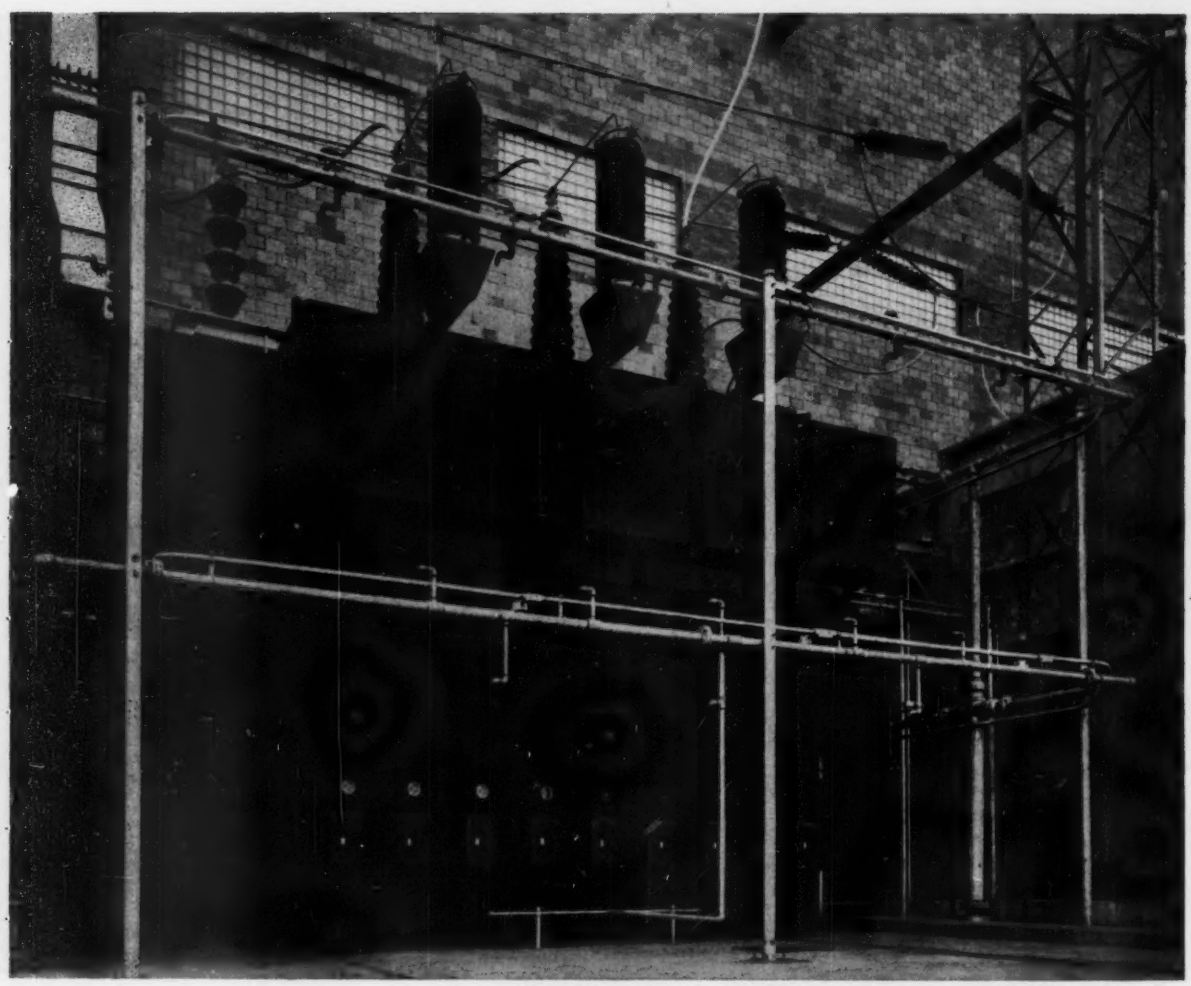
Cufenloy-30, containing nominally 70% copper and 30% nickel, is approved under the ASME Code, Case No. 1266, for unfired pressure vessels. This new alloy offers improved properties for OEM and retubing at a lower cost per bundle, yet without sacrifice of safety when substituted for 65/35 nickel copper alloy tubes. The Dual Gauge process provides a heavier wall thickness to compensate for thinning on outer portions of return bends.

Specially designed Phelps Dodge welding guns were used to weld these tubes to the tube sheets. This advanced method assures tighter tube joints with more positive, permanent protection against leakage. The guns are controlled by preset relays and timers that start, stop and regulate electrode motion, welding current and argon flow.

Whatever your tubing or re-tubing requirements, call on Phelps Dodge for highest quality products, research and technical advisory service—a complete program backed by more than 40 years of experience in the heat exchanger and condenser tube field.

PHELPS DODGE COPPER PRODUCTS
CORPORATION
300 Park Avenue, New York 22, N. Y.

P D



Grinnell Water Spray system protects transformers from fire at Phillip Sporn Station

Grinnell fire protection systems guard one of America's largest power stations against shut-down by fire!

The 450,000 KW Unit No. 5 of American Electric Power Company's Phillip Sporn Station at New Haven, West Virginia, makes it one of the largest in the country. Guarding this giant power station against fire — dependable Grinnell fire protection systems.

Look at this fire protection line-up!

Grinnell Water Spray systems protect two main transformers, two auxiliary transformers, the reserve auxiliary start-up transformer, the vital sections of the coal conveyor system, cable trays, auxiliary boiler feed pump oil tank, and the stator and seal oil unit. Grinnell Foam-Water system protects the basement floor area in the vicinity of the turbine pedestals.

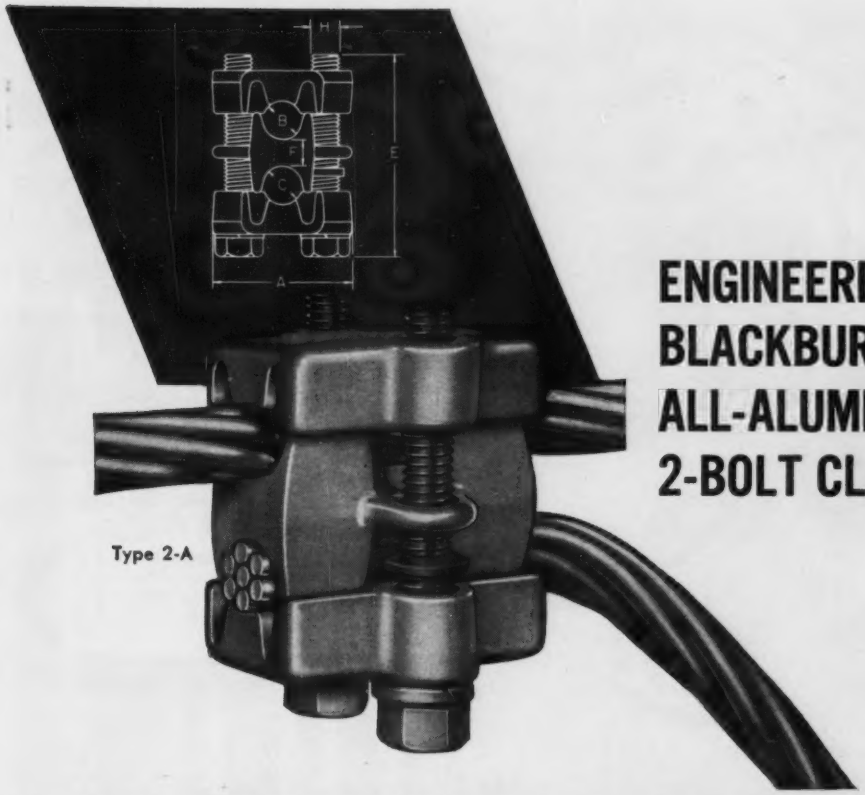
Grinnell-installed Carbon Dioxide systems protect the main boiler feed pump oil tank and the turbine oil and lube oil tank rooms. Grinnell-installed Dry Chemical systems protect the main turbine bearings, the stop and intercept valves, and the pedestal cavity behind the front standard.

Remember, whatever *your* fire protection needs, there's a Grinnell system just right for you. Send for the reprinted article, "How Good Is Your Fire Protection?", which details fire protection for generating stations. Write to Grinnell Co., Providence 1, R. I.

Grinnell Foam-Water system on duty in basement floor area

GRINNELL

FIRE PROTECTION SYSTEMS SINCE 1870



Type 2-A

ENGINEERED INTO BLACKBURN ALL-ALUMINUM 2-BOLT CLAMPS...

ALL WEATHER PROTECTION

On Aluminum or Bi-Metallic Connections

Contact surfaces guarded by rainshield design of castings—inhibitor will not "wash out" even under driving wind and rain.

Condensation is drained off through ports in castings regardless of installation position—never allowed to accumulate around the conductors.

Designed with hot stick crews in mind.

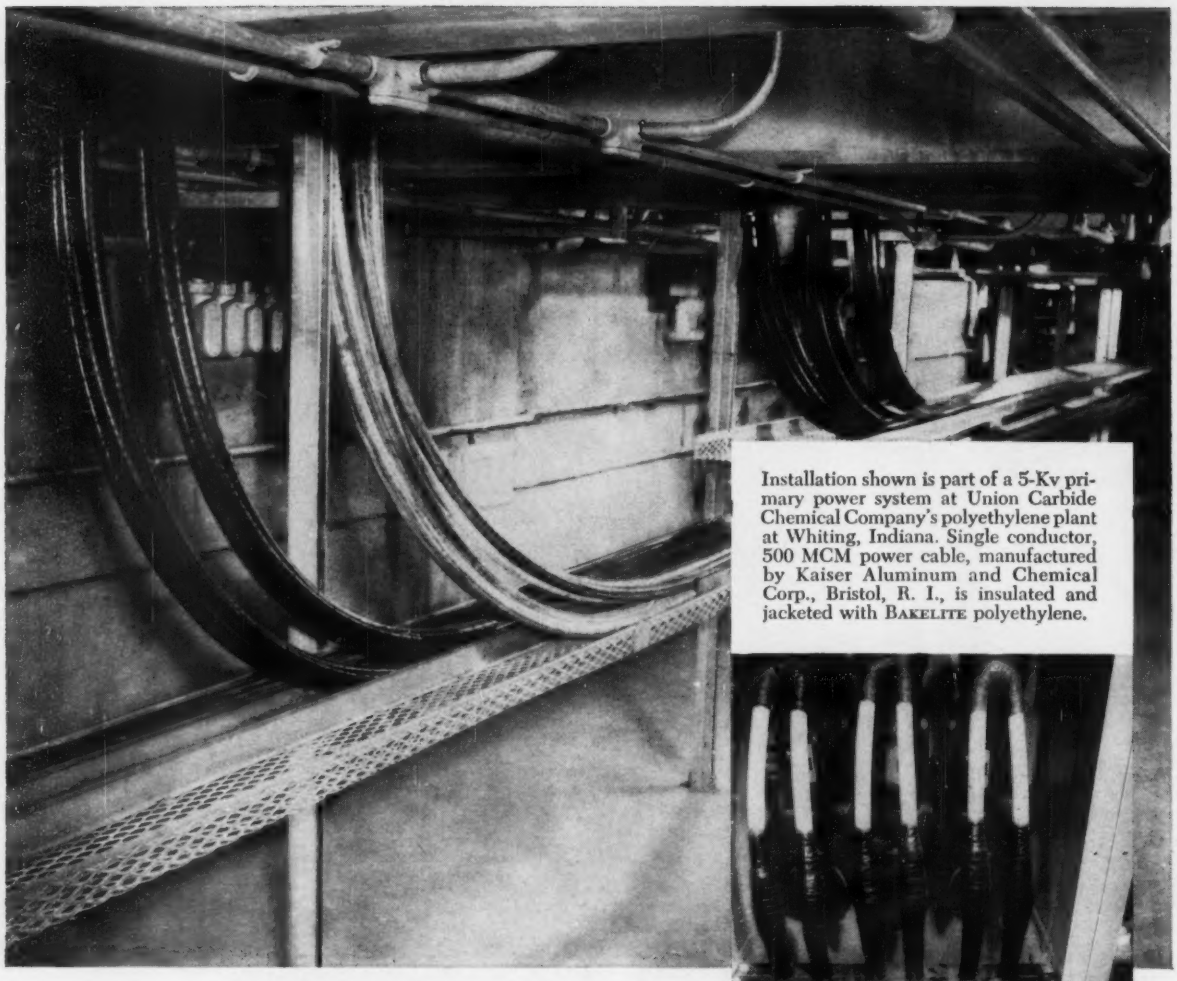
Massive all-aluminum clamp—including hardware—may be used on aluminum or on copper conductors with inhibiting compound. Extra thick, highly conductive aluminum spacer separates dissimilar conductors for added corrosion protection.

Four clamps accommodate a wide range of wire sizes—main from 6 to 795 ACSR, tap from 8 to 397.5 ACSR. Write for samples and literature.

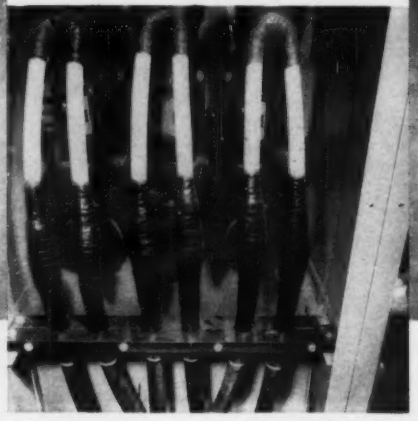
LIVE BETTER ELECTRICALLY

For complete information and test data: Send for Bulletin #6003

Jasper
BLACKBURN
Corporation
1525 Woodson Road • St. Louis 14, Mo.



Installation shown is part of a 5-Kv primary power system at Union Carbide Chemical Company's polyethylene plant at Whiting, Indiana. Single conductor, 500 MCM power cable, manufactured by Kaiser Aluminum and Chemical Corp., Bristol, R. I., is insulated and jacketed with BAKELITE polyethylene.



5-Kv Power Cable with

INSULATION AND JACKETING BOTH OF POLYETHYLENE

BAKELITE Brand polyethylene continues to prove its superiority as *both* an insulating and jacketing material . . . and this time in the same power cable construction. In the Whiting, Indiana polyethylene plant operated by Union Carbide Chemicals Company, 5-Kv power cable insulated and jacketed with BAKELITE polyethylene has been providing reliable, uninterrupted power service for two years without evidence of electrical or physical failure.

Over a million feet of 600 volt to 15-Kv power cable using BAKELITE polyethylene has been installed in various operating divisions of Union Carbide Corporation and has exhibited this same reliability. In specifying power cable insulated and jacketed with polyethylene, electrical engineers obtain these noteworthy property improvements over the other commonly used insulating material.

- Improved resistance to moisture, oil and chemicals
- Superior cold bend and impact properties
- Better abrasion resistance
- Greater resistance to deformation at operating temperatures
- Higher surface and volume resistivity
- Easier handling and installation
- Plus, exceptional low-loss electrical properties

Electrical utilities, electrical contractors and engineers, and cable manufacturers . . . all can obtain greater efficiency, longer service life and easier installation with power transmission and distribution wire and cable insulated and jacketed with high-quality BAKELITE polyethylene. For more information, write Dept. ID-43C, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada:* Union Carbide Canada Limited, Toronto 12.

UNION CARBIDE

BAKELITE and UNION CARBIDE are registered trade marks of Union Carbide Corporation.

entirely new and different

UPTEGRAFF "compact" U-65 TRANSFORMERS

built for 65° C temperature rise

lower price

lower ratio of losses

greater endurance

see following pages for details

YOU SAVE 3 WAYS

with Uptegraff U-65 Transformers

Designed for operation at 65°C rise, the new Uptegraff Transformers incorporate three related engineering innovations:

- *reduction in size*
- *low ratio of full load copper loss to core loss*
- *introduction of high temperature insulating materials*

With the U-65's, there is no sacrifice in transformer performance and they bring the following *extra* benefits:

1

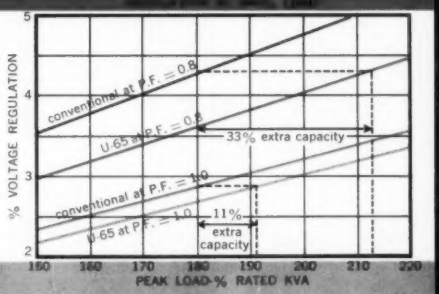
LOWER PRICE

Being more compact, the Uptegraff U-65 series of distribution transformers require less copper, steel, oil and other materials, permitting a saving which is passed along to the purchaser. Price savings may be as much as 7½%.

2

LOWER RATIO OF LOSSES

Operating economy in overloading is promoted by the lower loss ratio of the U-65 design. There is less voltage drop at peak load, and efficiency is high. This means greater customer satisfaction, greater tolerance for future load growth, greater operating revenue.



3

GREATER ENDURANCE

The new high-temperature insulation used in U-65 transformers has capacity for thermal endurance far exceeding the need of the higher temperature rating and the improved voltage regulation. Actually, the U-65 is one of the most conservatively-designed transformers offered today.

WHY THE 65° RATING?

Instead of offering a dual rated 55°/65° transformer, Uptegraff has developed the U-65 line, in standard NEMA ratings. Being designed and built for 65° operation, they provide better efficiency, better ratio of losses, lower cost.

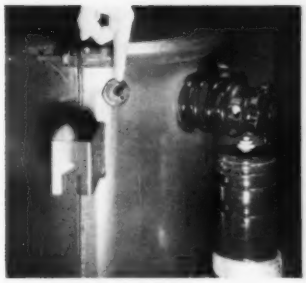
UPTEGRAFF U-65 TRANSFORMERS
have many unique features

High-temperature insulating materials

Five to ten times the endurance of conventional insulations at elevated temperatures is achieved through the use of epoxy insulated magnet wire rated for 150° C, special cyanoethylated kraft paper and high-temperature inhibited oil. Since the 65° design does not require more than twice the endurance of conventional materials, the New Uptegraff U-65 transformers, containing high temperature materials are actually more conservatively engineered than the conventional designs presently found acceptable.

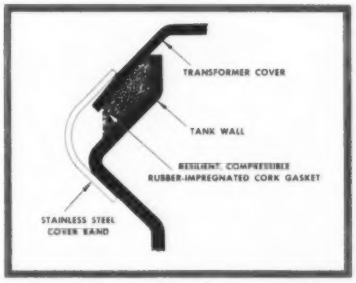
Exclusive provision for pressure testing

Photograph shows a special fitting by means of which a pressure test with dry air at 3 to 5 psi is made on every completed transformer. With this test, exclusive with Uptegraff, leaks which might not be discovered by the standard "inversion" tests are quickly detected.



Tight, reusable tank seals

A resilient, rubber-impregnated cork gasket is firmly and uniformly compressed between tank wall and tank cover by a special steel cover band — locking out air, moisture and other contaminating influences. Gasket is cemented to tank. Cover, may be removed repeatedly without changing gaskets.

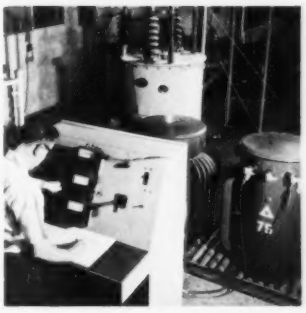


Easy and safe to handle and store

Uptegraff transformers are housed in palletized, rugged wooden crates for easy and safe handling, shipment and storage.

Every transformer fully tested

In addition to normal NEMA tests, a whole series of tests is applied on *every* transformer to assure mechanical and electrical integrity. These include checking core loss and exciting current, high-voltage impulse tests, and high-potential tests. There is no "sample" testing of Uptegraff transformers.



Low-loss core steel

Carefully selected M5W grain-oriented strip steel for wound core construction assures low exciting current and reduces weight and bulk.

New, tough cover coating

On transformers 7200 volts and over, the covers are plastic coated by a powder fluidizing process, providing exceptional protection from atmospheric conditions, wildlife and other hazards. Insulates for 20,000 volts. Endures a salt spray test of over 10,000 hours.

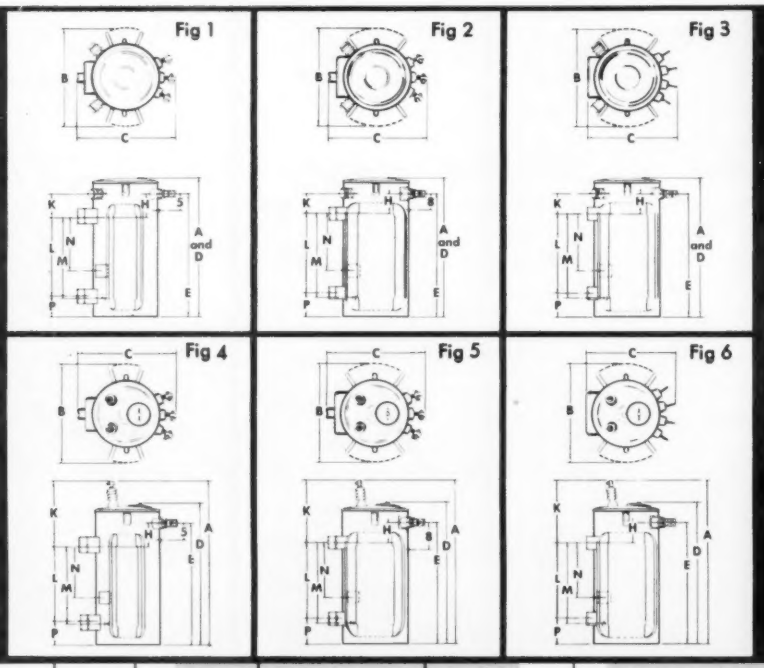
RECENT ARTICLES relating details of design as employed in the new U-65 transformers include:

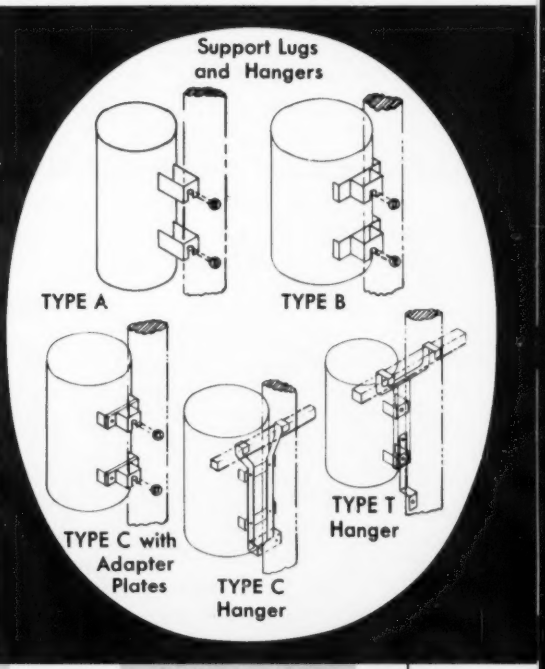
1. "Cyanoethylated Kraft-A Thermally Upgraded Cellulose for Transformer Applications" AIEE Conference Paper No. 5038.

2. "Reduced Loss Ratio Transformer Saves in Distribution Operation" by A. M. Lockie; ELECTRICAL WORLD, October 3, 1960.

3. "Transformer Losses and Loss Ratios" by Kenneth W. Klein, Cleveland Electric Illuminating Co., in ELECTRIC LIGHT AND POWER, July 15, 1960.

Electrical and Mechanical Characteristics of Uptegraff's new money-saving U-65 transformers





HIGH VOLTAGE RATING	LOW VOLTAGE RATING	KVA	LOSSES (WATTS)		PERCENT EFFICIENCY				PERCENT REGULATION		PER-CENT IMPED-ANCE	FIG. NO.	APPROX. DIMENSIONS (INS.)				NET WEIGHT (LBS.)		INTERCHANGEABILITY DIMENSIONS (INS.)							NEMA SUP-PORT LUG	NEMA CROSS-ARM HANGER
			No Load	Total	Full Load	¾ Load	½ Load	¼ Load	1.0 P.F.	0.8 P.F.			A	B	C	D	Without Oil	With Oil	E	H	K	L	M	N	P		
2400/4160Y (B.I.L.-60KV)	120/240 OR 240/480	10	56	201	98.0	98.2	98.1	97.4	1.5	1.8	1.8	1*	24¼	19⅞	19⅞	24¼	170	225	20	2	2	11¼	12	15	6¾	A	T1
		25	122	434	98.3	98.4	98.4	97.8	1.3	1.7	1.7	1*	30½	21	22⅜	30½	295	400	26	2	2	11¼	12	15	12¾	A	T1
		50	205	740	98.5	98.6	98.6	98.1	1.2	1.8	1.8	1	38½	26½	26½	38½	505	710	34	7	7	23¼	24	15	3¾	B	T2
		100	405	1435	98.5	98.7	98.6	98.1	1.1	1.6	1.6	2	40¾	30¾	30¾	40¾	885	1150	35	7	7	23¼	24	15	4¾	B	T2
		167	725	2260	98.6	98.7	98.7	98.0	1.0	1.9	2.1	3	44¾	31¼	32¼	44¾	1350	1660	37	7	7	24	24	15	6	C	C1
4160/7200Y OR 4800/8320Y OR 2400/4160Y X 4800/8320Y (B.I.L.-75KV)	120/240 OR 240/480	10	56	216	97.9	98.1	98.0	97.4	1.6	1.9	1.9	1*	24¼	19⅞	19⅞	24¼	175	230	20	2	2	11¼	12	15	6¾	A	T1
		25	122	467	98.1	98.3	98.3	97.7	1.4	1.8	1.8	1*	30½	21	22⅜	30½	300	405	26	2	2	11¼	12	15	12¾	A	T1
		50	205	805	98.4	98.5	98.5	98.0	1.2	1.8	1.8	1	38½	26½	26½	38½	510	715	34	7	7	23¼	24	15	3¾	B	T2
		100	405	1485	98.5	98.6	98.6	98.1	1.1	1.6	1.6	2	40¾	30¾	30¾	40¾	890	1155	35	7	7	23¼	24	15	4¾	B	T2
		167	725	2295	98.6	98.7	98.7	98.0	1.0	2.0	2.2	3	44¾	31¼	32¼	44¾	1355	1665	37	7	7	24	24	15	6	C	C1
7200/12470Y OR 7620/13200Y (B.I.L.-95KV)	120/240 OR 240/480	10	67	241	97.6	97.8	97.8	97.0	1.8	2.0	2.0	4*	32	17⅞	19⅞	26½	180	235	20	2	14	11¼	12	15	6¾	A	T1
		25	141	501	98.0	98.2	98.1	97.4	1.5	2.0	2.0	4*	38	19¾	22¾	32½	305	410	26	2	14	11¼	12	15	12¾	A	T1
		50	235	840	98.3	98.5	98.4	97.8	1.3	1.8	1.9	4	46	26½	26½	40¾	520	725	34	7	19	23¼	24	15	3¾	B	T2
		100	430	1515	98.5	98.6	98.6	98.0	1.1	1.7	1.7	5	43¼	30¾	30¼	42¾	900	1165	35	7	20¼	23¼	24	15	4¾	B	T2
		167	750	2295	98.6	98.7	98.6	98.0	1.0	2.2	2.5	6	52¼	31¾	32¼	46¾	1375	1685	37	7	20¼	24	24	15	6	C	C1
12000 OR 13200 OR 13800 OR 14400 (B.I.L.-95KV)	120/240 OR 240/480	10	67	245	97.6	97.8	97.8	96.9	1.8	2.3	2.3	4*	32	17⅞	19⅞	26½	180	235	20	2	14	11¼	12	15	6¾	A	T1
		25	141	506	98.0	98.1	98.1	97.4	1.5	2.0	2.0	4*	38	19¾	22¾	32½	305	410	26	2	14	11¼	12	15	12¾	A	T1
		50	235	860	98.3	98.4	98.4	97.8	1.3	1.9	1.9	4	46	26½	26½	40¾	520	725	34	7	19	23¼	24	15	3¾	B	T2
		100	430	1530	98.5	98.6	98.6	98.0	1.2	2.0	2.1	5	48¼	30¾	30¼	42¾	900	1165	35	7	20¼	23¼	24	15	4¾	B	T2
		167	750	2295	98.6	98.7	98.6	98.0	1.0	2.2	2.5	6	52¼	31¾	32¼	46¾	1375	1685	37	7	20¼	24	24	15	6	C	C1

*No cooling tubes required.

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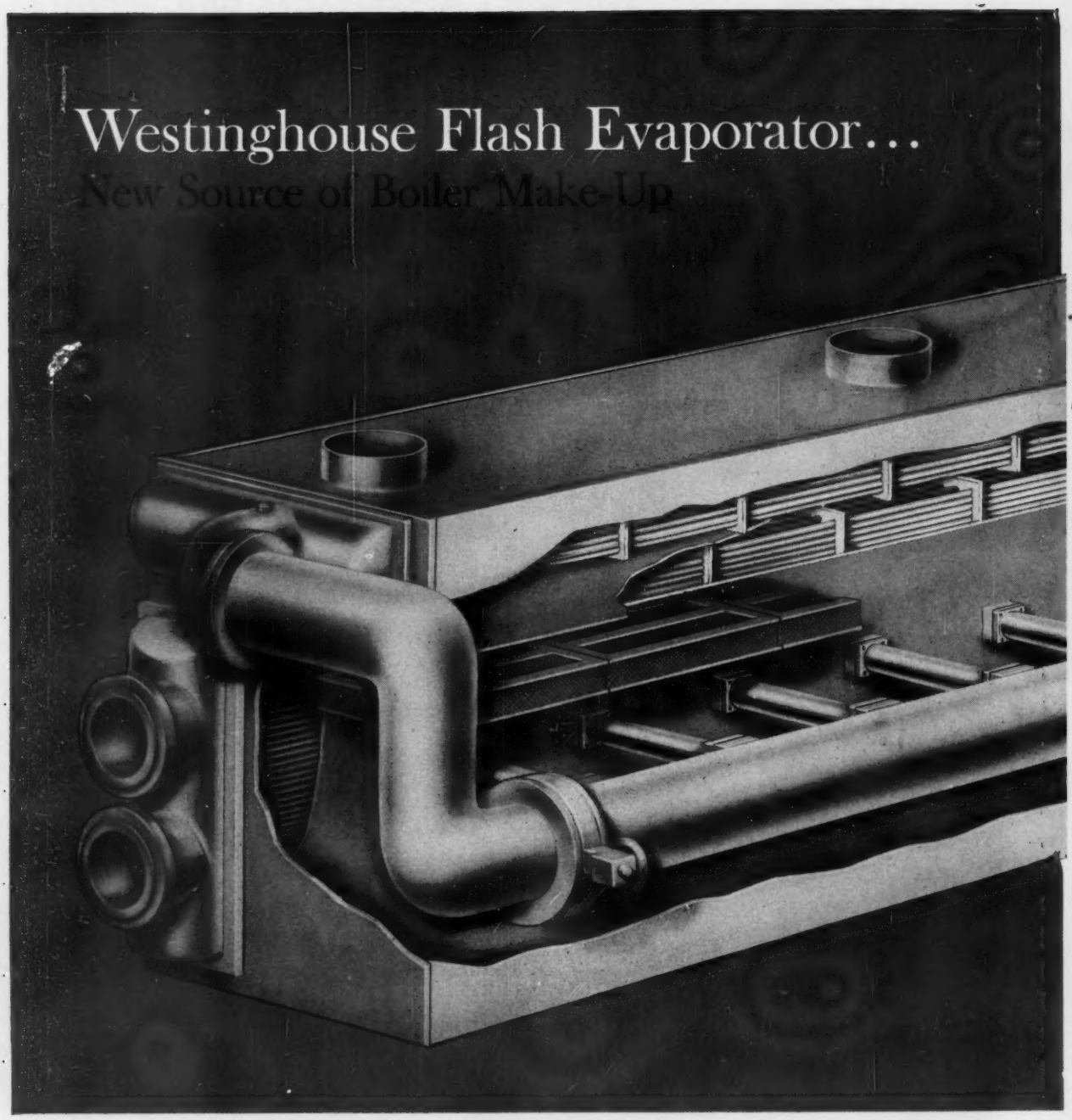

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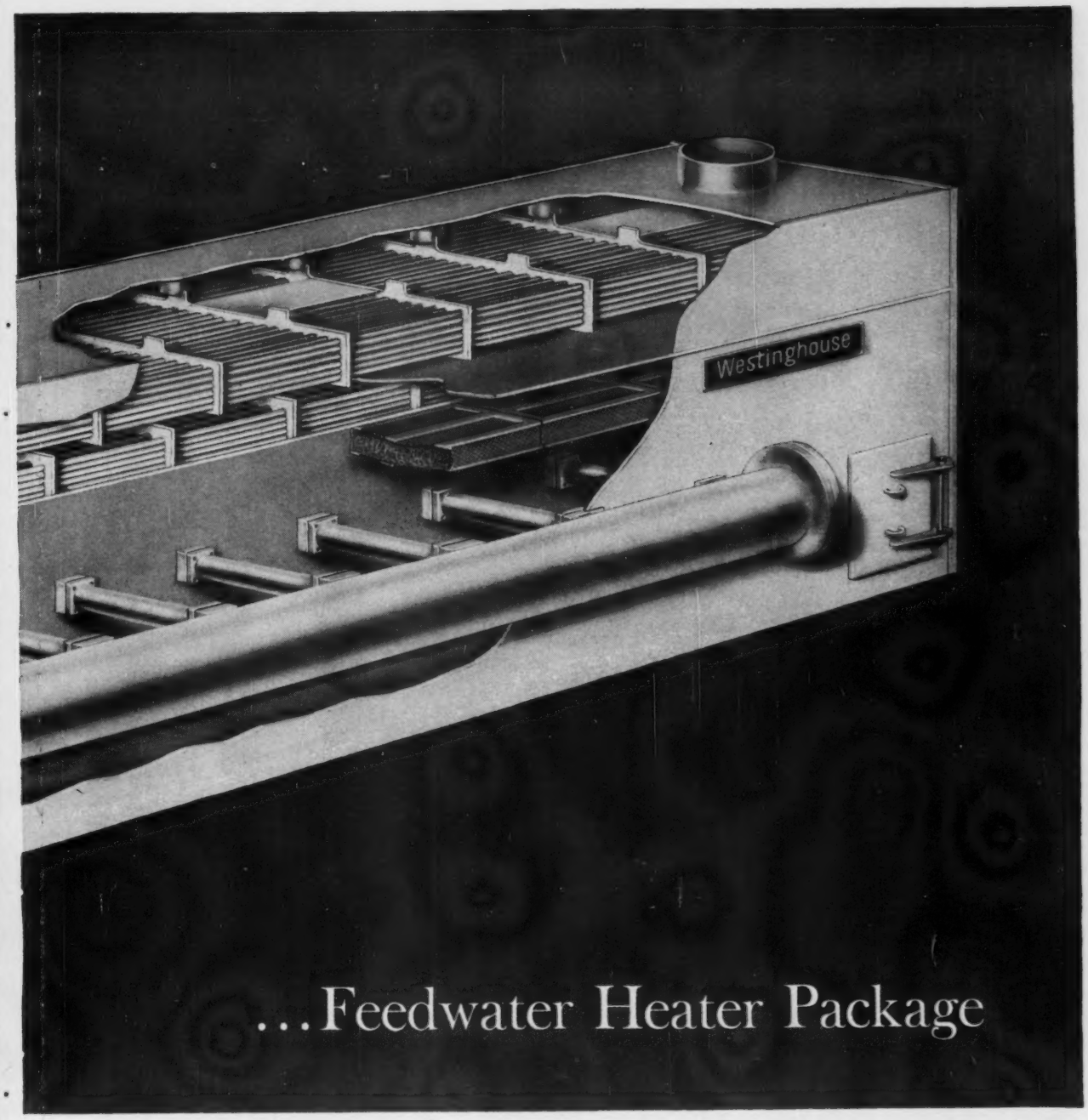

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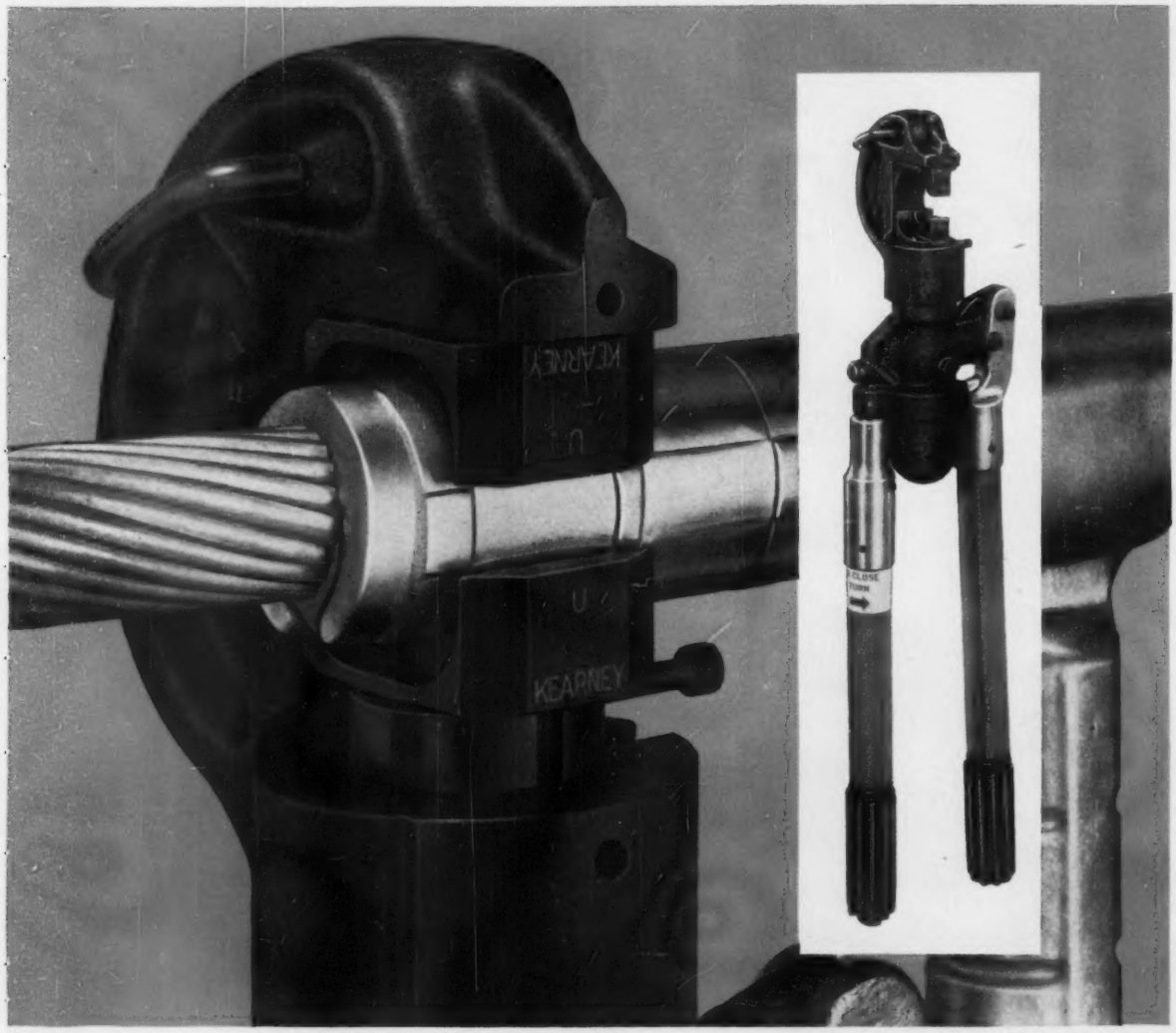

This is the tool... Kearney does it again! The Kearney WH-2 Hydraulic Tool—big brother to the WH-1 Tool—is the FIRST and ONLY portable, hand-operated, hot-line compression tool to accommodate such a wide range of fitting and conductor sizes. Equipped with only this ONE tool linemen can now install tap compression connectors on all sizes of energized and non-energized conductors from #6 Solid through 636 MCM ACSR! Die sizes are the same as those for the Kearney WH-1 Tool, plus the additional sizes required to install the larger fittings shown on the opposite page. Dies snap in or out easily . . . can be secured with a set-screw. A two-step, high speed pump generates full 21,000 pounds of thrust. An automatic overload valve prevents over-compression. Large C-frame head allows clear view of work area while making indents. A partial rotation of one handle sets tool to compress or retract dies—no need to remove either hand from handles. Interchangeable insulated handles are available in various lengths to adapt tool to individual voltage requirements.

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. . . extend the connection range to include installations on all "Hot" or "Cold" lines from #6 Solid to 636 MCM ACSR

Two-piece L-Squeezon Tap Connector
Two-piece T-Squeezon Bolted Tap Connector (4-hole terminal pad)
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Aluminum Squeezons
Two-piece T-Squeezon Compression Tap Connector
Cast Aluminum Terminals (2 and 4-hole pad)
Two-piece Cross-Tap Connector
Two-piece Repair Sleeve

These are the fittings . . . New, larger Kearney tap connectors and the Kearney WH-2 Hydraulic Tool now extend the tap compression connection range to include installations of highest electrical efficiency on energized or non-energized conductors as large as 636 MCM ACSR. Kearney two-piece aluminum tap connectors accommodate large conductor sizes from 266.8 MCM through 636 MCM ACSR. Tap units slide into and interlock with an encircling sleeve unit. Sleeve for any one conductor size will accept interchangeably various tap units of the same size range. Kearney interlock design aids installation . . . insures uniform compression and full-circumference contact . . . eliminates strand cutting. Sufficient connector mass without excess weight assures cool-running connections. Interchangeability of tap units helps reduce storekeeper inventories.

Also illustrated: Kearney Cast Aluminum Terminals, accommodating wire sizes from #2 ACSR to 1000 MCM Str.; Aluminum Squeezons for wire sizes from #6 Solid to 397.5, line or tap.

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NOW! All Ratings through 500 KVA "Pole Mounted"

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ALL NEW "500"

Total weight 3100 lbs. Height only 50 inches. Losses cut 32%. New compact designs store more than double KVA for the same given weight. Dual ratings (500 and 560 KVA) offer 12% more KVA with no sacrifice in operating life.

ALL NEW "333"

Weight cut 50%. Height 46½ inches. Losses reduced 29%. New designs feature a lighter, more compact core and coil and dual ratings (333 and 373 KVA).

ALL NEW "250"

Weight cut 50%. Height reduced 32 inches. Losses 29% lower. Like the "500" and "333", this modern, lightweight design offers a big boost in mountable KVA per pole.

CONVENTIONAL "TYPE C"

And type B (two bushings) feature famous low-loss Bent Iron Core, compact coil, Quick-Grip bushings, celuclad covers, SPI-65 super insulation and dual-ratings.

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Now, lighter than ever with lower losses. Core and coil have been redesigned for greater economy. New designs weigh 1500 lbs. Dual ratings 167 and 187 KVA are offered.

COMPACT 25 KVA

Height 36½ inches including bushings. Width 22 inches. Depth 21¼ inches. Greater compactness puts more KVA per pound on pole—allows change-outs to higher KVA on existing poles.

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takes only two controls to put it through its paces

Simplicity of operation is the big difference between the Series EM-2 "Earth-Master" and ordinary hydraulic diggers which require movement of three or four levers to dig a hole of comparable size. Unlike diggers that depend on the derrick for down pressure, the frame-guided EM-2 provides direct digger control — with full power down feed exerting several thousand pounds of pressure. Auger can be reversed, run at low speed for digging or at high speed for spin-off. Installed on a live-boom derrick like the Series PM-20 "Pole-Master" shown, this portable unit provides the power and operating features of a fixed-position digger.

Digger and derrick are hydraulically powered . . . controlled independently to permit digging while pole is suspended, an especially valuable feature where cave-in is possible. Pole can be set just as soon as the hole is dug.

Twin-column telescopic frame, which stows out of the way when derrick is needed for normal hoisting, also serves as a ground prop for pole-pulling and for increased derrick capacity.

SERIES EM-2 "Earth-Master" Hydraulic Hole Digger
DIGS VERTICALLY OR AT ANGLES . . . FROM 9" TO 30" IN DIAMETER, UP TO 10' 6" IN DEPTH

SERIES DF-1 *"Earth-Master"* Hydraulically-powered . . . digs to 10'6" deep, 9" to 20" in diameter. Shown above on a Series PM-10 "Pole-Master" Derrick.

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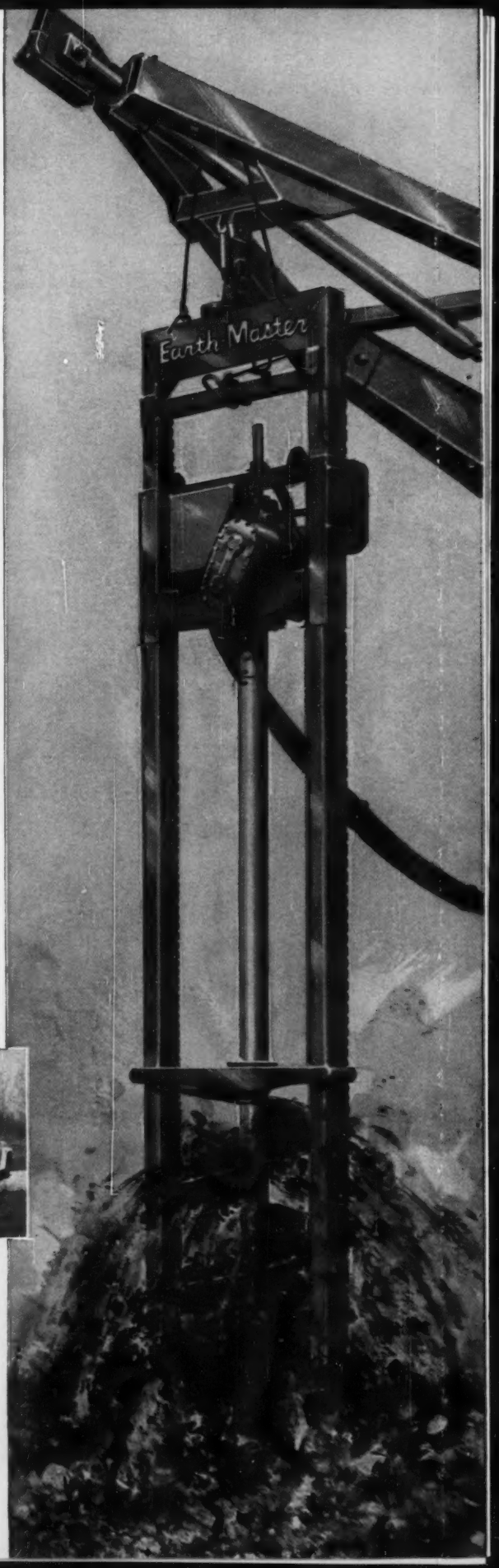

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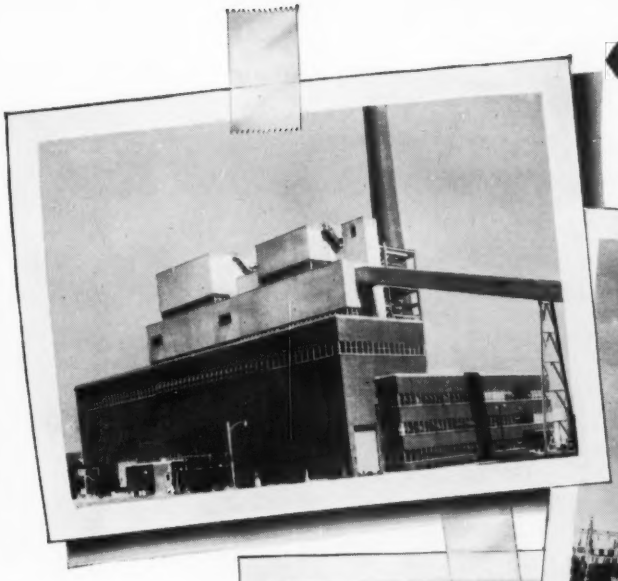
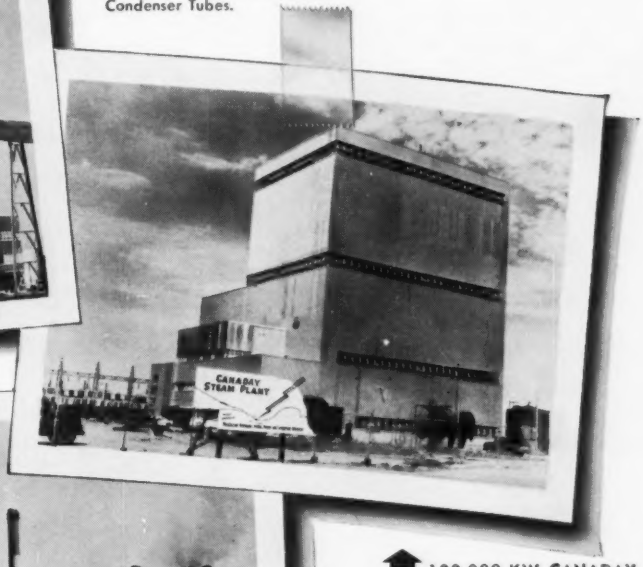
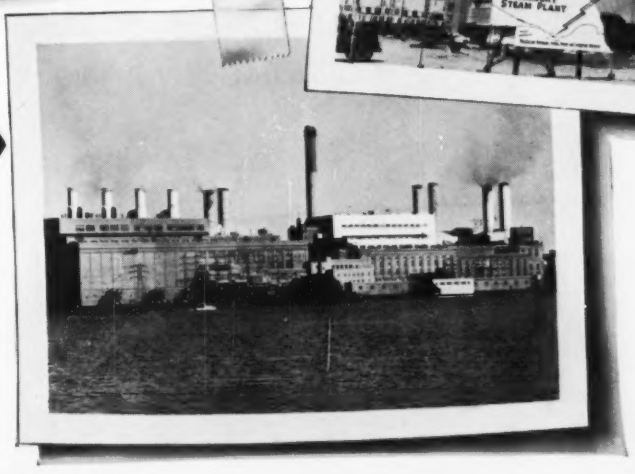


ILLINOIS POWER COMPANY'S Vermilion Plant near Danville, Ill., with 183,000 KW capacity. #2 condenser equipped with 162,288 pounds of Revere Admiralty Condenser Tubes.



100,000 KW CANADAY STEAM PLANT of the Central Nebraska Public Power & Irrigation District. Here you'll find Revere Muntz Metal tube sheets combined with Revere Copper Condenser Tubes.



THE NIAGARA MOHAWK POWER CORPORATION'S Huntley Steam Station, Buffalo, N.Y. with 196,000 pounds of Revere Admiralty CondenserTubes and 29,000 pounds of Revere Muntz Metal tube sheets installed in its Unit #67.

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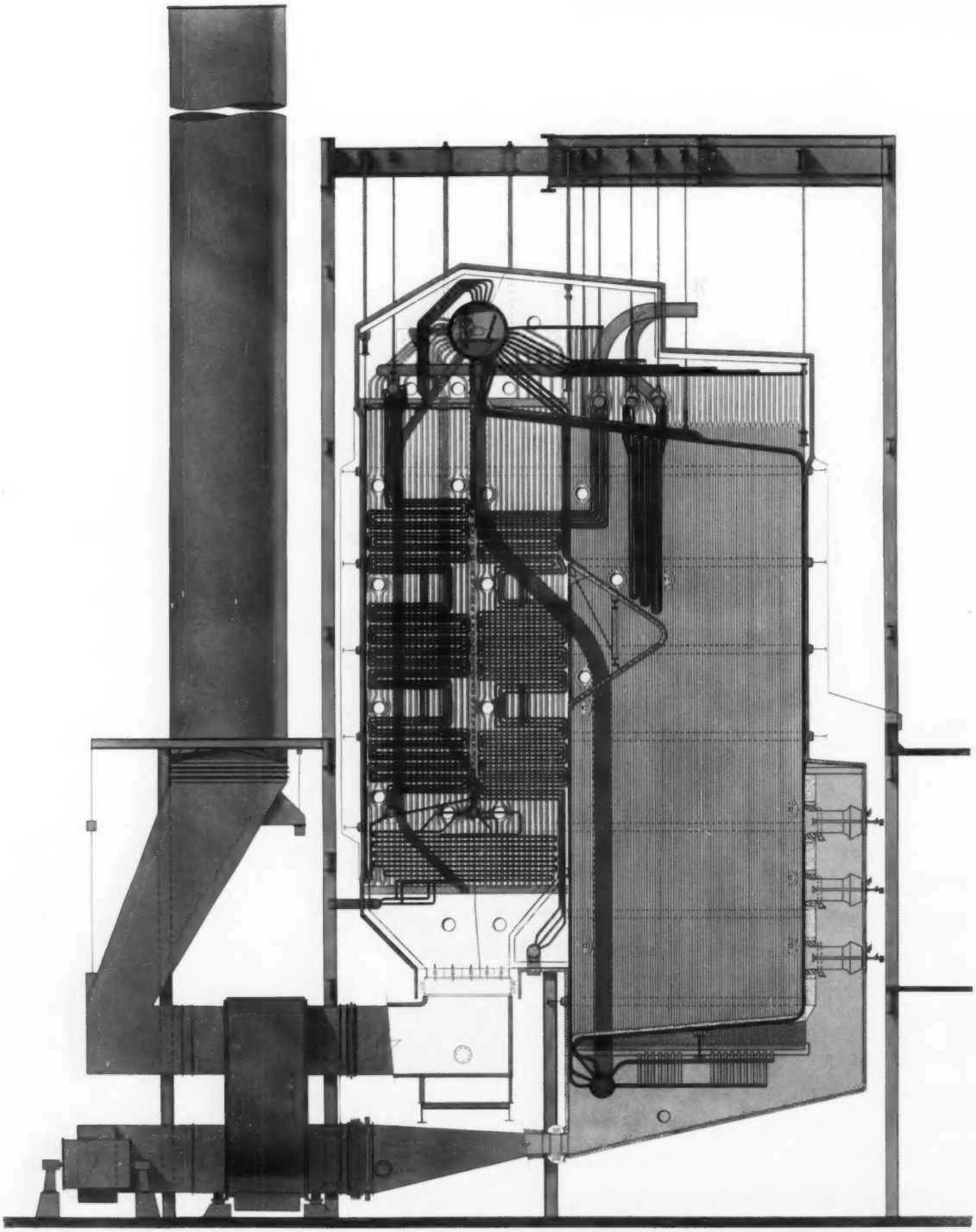


A careful survey of your plant by a qualified consulting engineer could show ways of making substantial savings in power costs.

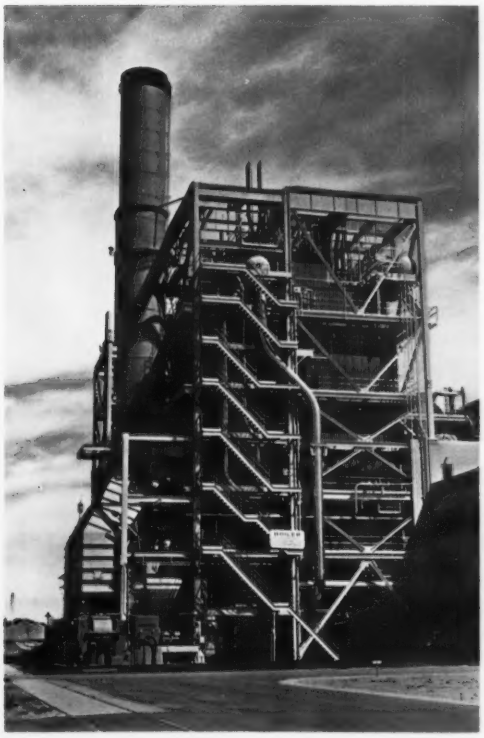
Another RILEY Boiler in Texas Helps to Boost Productivity in the Lower Rio Grande Valley

No. 2 Boiler
J. L. Bates Power Station
Central Power and Light Company

Engineering Data

Steam Capacity — 750,000 lbs/hr
for 4 hours — 800,000 lbs/hr
Design Pressure — 1750 psig
Superheat — Reheat 1005/1005F
Steam Temp. Control — Spray, Dampers
Fuel — Gas and Oil
Pressurized Setting
Efficiency — 88.10%

Sargent & Lundy
Consulting Engineers



During 1960 Central Power and Light Company, Corpus Christi based Texas utility, completed an extensive expansion program to its system with the installation of the No. 2 unit at J. L. Bates Power Station near Mission, Texas in the Rio Grande Valley. This unit adds 110,000 kilowatts to the system capability, bringing it to 953,000 kw — five times the capability of 10 years ago.

The Riley Reheat Boiler was selected as a result of a program designed to lower the cost of kilowatt production and to offset the increase in the cost of fuels.

Central Power and Light Company is one of several Texas utilities using Riley boilers. A total of over 16 million pounds of Riley steam has been purchased by utilities for Texas central stations since 1950, indicating the industry's remarkable growth, and increasing acceptance of Riley steam generating and fuel burning equipment.

RILEY UTILITY BOILERS IN TEXAS (Installed and on order)

HOUSTON LIGHTING & POWER CO.	11 Units —	6,440,000 lbs/hr
TEXAS ELECTRIC SERVICE CO.	4 Units —	5,861,000 lbs/hr
DALLAS POWER & LIGHT CO. .	3 Units —	3,450,000 lbs/hr
CENTRAL POWER & LIGHT CO.	1 Unit —	725,000 lbs/hr
SOUTHWESTERN POWER CO. .	1 Unit —	650,000 lbs/hr
SOUTHWESTERN PUBLIC SERVICE	1 Unit —	330,000 lbs/hr

RILEY

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RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS.

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RT&E INTRODUCES ARMORTEC

A New Lifetime Plastic Coating on All RT&E Pole-type Transformers —At No Additional Cost

The transformer industry has been missing the boat. In the last few years, development of various features in distribution transformers have been extremely rapid — transformers with dual voltage ratings, units designed for economical residential underground distribution, longer insulation life, and yet, all of us have been missing one of the most obvious areas where improvement in the distribution transformer should have been made — and that is in the finish that protects the transformer.

There have been paints and more paints developed for protection of distribution transformers; none really solving the problem. There is a better way of doing it which RT&E has recently adopted for all pole-type distribution transformers. This is a 100% solids system involving fusion bonding of pure vinyl to the transformer tank. We call it Armortec. This is a process radically superior to any paint finish now being used. It involves no solvent to dilute the solid materials in the finish and it involves no high pressure spraying to blow the covering material out of the crevices that need protecting.

Armortec is not a paint. It is a pure vinyl plastic. Dipped in the resin and fusion-bonded at 650°, the transformer tank, band, and cover is provided with a thick protective coating over all portions of the transformer, even sharp edges.

The superior adhesion quality is due to the fusion-bonding method using high temperature oven curing. The protective coating is of a uniform thickness, even on sharp edges and in corners. This uniform coverage fills in blind spots and corrosion traps present around lifting lugs, hanger brackets and accessories.

The fused on finish is also completely smooth. There is no problem with sag, pock and drip marks. Armortec will not chalk, crack or craze in weather and sunlight. It provides a lasting glossy, attractive appearance throughout the life of the transformer.

This process and the materials being used have been thoroughly tested in accelerated life laboratory tests equivalent to 20 years field service. These tests have shown that new Armortec finish is corrosion-proof, fade-proof and maintenance-free. There have also been three years of testing in the very worst climatic and corrosion conditions in Florida and Arizona. All of these tests show Armortec to be many times superior to paint in all respects.

This vinyl material can also be laid on the tank in much greater thicknesses than can paint. Normal paint is put on the tank between three and four mils thick. We are using 8 to 10 mils on the tank and about 20 mils on the cover and band. With this type of thickness on the cover, it also provides 1100 volts/mil of insulation, thereby eliminating outages due to birds and other animal life.

In addition, the mechanical properties of this material provide an extra tough resilient coating over the tank that resists chipping, cracking, scratching and other normal damage which can occur in handling the transformer between the manufacturer's warehouse and its final installation on the pole.

This Armortec finish is truly a lifetime transformer coating in all climatic or corrosive conditions encountered anywhere in the country. This outstanding finish is being provided *at no price addition.* It will be provided on all RT&E distribution transformers . . . and how can this amazing Armortec be provided on all units at no extra cost? The answer is simple. RT&E insists on the best and concentrates on a single idea — a better transformer. Here is a transformer finish that is radically new, and will solve all corrosion problems involved in a transformer installation.

RT&E Corporation
Waukesha, Wisconsin
Portland, Oregon • Arlington, Texas

Ask your RT&E representative to demonstrate this Armortec finish.

Government Moves on Pacific Intertie

An ambitious, imaginative interconnection, which would form a common carrier bulk transmission link from the Pacific Northwest to California, has been proposed (see p 58). It—or some adaptation—may well be started as a federal project at an early date.

It is becoming evident that regional and inter-regional common carrier lines are going to be built. They certainly will be federal, or at least federally dominated, whenever the investor-owned utilities do not present plans which:

- Take the initiative,
- Capture the imagination, and
- Compete economically with federal alternatives.

Meeting these requirements probably is one of the most difficult tasks to face the investor utilities in the coming years. But the alternative—a complete EHV federal overlay of all systems—represents a serious threat to the private utilities' control of their own plans and destinies.

The President has directed the Interior Secretary to "develop plans for the early interconnection of areas served by the Department's marketing agencies." The proposed interconnection, by tying Bonneville Power Administration to the Bureau of Reclamation's California Central Valley Project, would do just that. More: It would run beyond CVP to connect Los Angeles, to form the power backbone of California's massive water-transport plan.

The Zinder report, proposing the $210-million, 500-kv, two-circuit, 950-mile connection, was prepared for the State of California, but that is a technicality. Secretary Udall has appointed a committee (see p 55) to study the interconnection. It takes little imagination to conclude that the committee will recommend federal construction of all or a major part of the line. It matters little that Zinder's premises can be attacked or that he stretched his economic justification.

Actually, the Pacific Coast investor utilities did take the initiative. Two years ago, at BPA request, Pacific G&E offered to build a $5.8-million, 95-mile, 230-kv, single-circuit, wood-pole line to connect the perimeters of the Pacific Northwest and Southwest bulk systems. Though supported by BPA then, the plan stymied politically. It was a good plan, capable of quick action.

But it had none of the elements of bold imagination which will be needed increasingly from here on. This is in distinction to the Rocky Mountain five-company plan for the Upper Colorado transmission. The latter had all the elements of bold imagination and timing, but may have fallen short on the question of wheeling rates. At least that's the excuse the Administration is giving for not backing it.

As we see it, there is no excuse, considering what will happen otherwise, for investor utilities in each area not producing strong interconnection plans for early joint action according to the common carrier concept. Indeed, a good many such plans are pending. Admittedly, the question of competing economically with tax-free and low-interest government alternatives presents terrific problems.

But this would not be the first time that the investor utilities have put risk capital into plans for which they have not been able to prove immediate payout. The salvation in this case would seem to lie in having a stronger faith in the future of load growth in their areas, and in applying the most liberal judgment possible when setting the present line-use rates.

Northwest System Coordination Gets

Canadian treaty points up need for close coordination to realize maximum benefits from upstream storage in Canada

A coordination agreement for all generating systems in the Pacific Northwest—federal and non-federal—is getting strong backing and intensive study this year.

A legal, binding coordination agreement has been the goal of many systems in the area for years. Such an agreement, it has been estimated, might add as much as 1 million kw of prime power for signing systems. It would replace the present, voluntary status of the Northwest Power Pool.

Real impetus for the coordination agreement negotiations, now underway, has come from the proposed Canadian treaty for Columbia River development.

Without such coordination—to assure proper use of river flows and power operations—much of the added power assumed in the treaty for the US may not be realized, and assessments for the assumed power additions may be difficult, if not impossible, to calculate.

Negotiations won't be completed for many months, perhaps even years. But time isn't a major factor at present. First flows from the proposed Canadian storage projects (Arrow Lakes, Duncan Lake, Mica Creek dams) wouldn't be available to the US for at least five years.

Present negotiations on the agreement, now underway between private, public systems and Bonneville Power Administration raise several important issues:

• An agreement, arrived at by the systems themselves, would dissolve a major knot the Federal Power Commission has been trying to untie for years. The FPC is charged, under Section 202 of the Federal Power Act, with the duty "to promote and encourage such interconnection and coordination," and has done its best in the past to persuade utilities to enter into such agreements with other systems in their regions. The FPC simply doesn't have the staff to carry out its own studies of such agreements, and very little has been accomplished toward coordinated operations between non-federal systems.

The FPC has looked to the Pacific Northwest as the area where the greatest benefit could be achieved from coordination, and as the area most difficult to coordinate.

• The possible indirect payments for "headwater benefits" to non-federal dam operators by the federal government—under terms of the Canadian treaty and a coordination agreement—could set off a bitter fight by, and among, public power spokesmen. Section 10 (F) of the Federal Power Act requires non-federal dam operators to pay upstream federal reservoirs for any added power ("headwater") benefits the non-federal dams may receive because of river control by the upstream reservoirs. However, no payment by downstream federal, to upstream non-federal operators is required, and the FPC for many years has tried to correct this "one way street." But public power spokesmen have criticized the proposed federal payments as a possible financial "bonanza" for already-licensed non-federal dams.

Last year, however, several public utility districts in the Pacific Northwest broke from the traditional public power stand, and favored the change as part of a coordination agreement.

• The Kennedy Administration may try to hand Northwestern Congressional leaders a final coordination agreement — boosting power output in their area—in trade for their agreement to the proposed Bonneville-California high-voltage transmission line (see p 55 and p 58).

• The coordination agreement also must act as the vehicle to "make whole" the reduced firm capacity at several dams on tributaries which, paradoxically, will result from the added prime power for mainstream Columbia dams. These dams are: Hungry Horse and Albeni Falls (federal), Kerr and Thompson Falls (Montana Power), Noxon and Cabinet Gorge (Washington Water Power), Box Canyon (Pend Orielle PUD No. 1), Chelan (Chelan County PUD No. 1), Brownlee and Oxbow (Idaho Power). The reduced firm capacity at these dams is a result of the changed water drawdown period as a result of added Canadian storage—from seven months in 1936-37 to 20 months in 1941-43.

The agreement would take these losses into consideration in determining coordinated river and power operations for the area. Incidentally, there's some disagreement between the Northwest systems as to whether dams suffering reduced firm capacity should be given or sold an equal amount to "make them whole."

Interior Secretary Stewart Udall has named Bonneville Administrator Charles F. Luce as his principal representative in negotiating an agreement with non-federal systems. Luce also will work with Chief of Engineers, Lt-Gen Emerson Itschner. Ten Northwest groups have retained Gordon Culp, an attorney for Corporate Services, Inc, to represent them in the negotiations. They are Washington Water Power, Montana Power, Pacific Power & Light, Portland General Electric, Puget Sound Power & Light, Pend Oreille PUD No. 1, Chelan County PUD No. 1, Grant County PUD No. 2, Eugene (Ore.) Water & Electric Board, Aluminum Co of America.

Culp, representing the ten organizations, gave the federal government a list of objectives for coordination operations.

Bonneville Administrator Luce, backed by Udall, subsequently listed the federal government's 12 coordination principles "to provide the region, and each of the participating parties, with maximum low-cost power benefits. . ."

Four of the above points were questioned on interpretation by the non-federal systems more to get a specific interpretation of them than as criticism. They set down their interpretation of the points, and the federal government has indicated these views are correct. The points are:

• **"Principle (C)** and the matters

Attention

covered by it will require continuing thought to assure the proper approach. Presently you intend that storage will be managed to assure the area firm load carrying capability before any party's secondary loads in excess of such capability are provided for and that an owner's interruptible industrial loads will be protected before releasing storage to serve other parties' secondary energy demands.

• "Under **principle (H),** it is intended that all reservoir owners, whether federal or non-federal, receive compensation either in money or through credits or offset for use of the reservoir in the coordinated operation. The amount of payments, credits or offsets for benefits to downstream projects, would be equitably determined on a cost basis through the application to all parties of a general formula. In the case of downstream federal projects, no money payments would be made to non-federal reservoirs, but appropriate credits of offsets would be made by the government through a central account.

• "It is understood that **principle (I)** intends that firm loads of the owner of transmission facilities are to be carried, then energy exchanges to carry area firm loads and, after these loads are carried, the owner shall have the right to use his transmission facilities for the owner's secondary loads before such facilities are available for secondary transfers of others.

• "It is the intent of **principle (J)** that as much operational criteria for all facilities in the area be set forth in the contract as is practicable. To handle additional criteria and problems which arise or which cannot be detailed in the contract, a cooperative liaison among the parties should be provided. The intent is to set up a mechanism which will be effective."

As presently proposed, the coordination agreement wouldn't require a "river master" to run the power pool's operations. Instead, representatives of the various systems would be stationed at a central point, probably Portland, to maintain the day-to-day reporting necessary to carry out coordination.

Both federal and non-federal spokesmen are extremely hopeful that an agreement can be reached. Bonneville spokesmen feel the non-federal systems have made a major contribution in their listing of proposed coordination principles, which, for the most part, agreed with the governments.

Principles of Agreement Set Down by Government

(A) No party shall be required to operate the facilities in a manner inconsistent with non-power uses or functions as determined by such party, or as required pursuant to law.

(B) The power facilities of the area shall be operated so as to produce optimum firm load-carrying capability for the area. The coordination contract shall include provisions for **(1)** the storage and release of water by all reservoirs in the US and, to the extent permitted by the treaty, by the reservoirs in Canada, and **(2)** the generation and exchange of power and energy including, at the option of each storage owner, such exchanges in lieu of storage releases.

(C) Upon demand by a downstream storage beneficiary, the owner of storage shall release water in excess of its needs to vary firm loads and its anticipated secondary loads, or such owner shall supply energy in lieu thereof.

(D) Each system shall be entitled to the full load-carrying capability that the system can produce during the critical period of the area with full storage releases; except that if, as a result of the additions of Canadian reservoirs under the terms of the treaty, the critical period energy capability of any project (including those under construction on Jan. 17, 1961) is reduced, the owner of any such project shall be entitled to purchase energy for restoration of its losses from owners of projects gaining.

(E) Energy shall be exchanged between systems to enable each system to maintain its firm load-carrying capability.

(F) Energy in excess of that required to supply the area load may be stored by any system entitled thereto in any reservoir with available storage space.

(G) The obligation under article V of the treaty to provide capacity and energy for delivery to Canada shall be shared by all projects in the area in proportion to the capacity and energy benefits resulting directly and indirectly to each project from the Canadian storage.

(H) Equitable compensation shall be provided by non-federal parties which benefit from reservoirs in the US consistent with applicable laws, the government will allow equitable credits of offsets for benefits received by the US from non-federal reservoirs.

(I) To the extent consistent with the owner's requirements, interconnecting transmission facilities shall be utilized and operated to accomplish the objectives of the coordination agreement.

(J) The coordination agreement shall include criteria for coordinated operation of all power facilities of the parties. In accordance with such criteria, each party will consult with the others in developing detailed plans for operation of its facilities.

(K) Equitable charges will be made for capacity, energy, transmission, storage, and other services.

(L) The Bonneville Power Administration will sell to a non-federal utility at the Bonneville "F" rate, which is now $9 per kw-year, the amount of capacity which it needs for delivery to Canada under the treaty.

B. C. Hangs Back on Treaty

In Canada, outlook for ratification of the Columbia River treaty is clouded, though Justice Minister E. Davie Fulton says the Canadian government is ready to proceed. Complicating ratification is the failure of British Columbia to accept the federal government's proposal to finance the projects, turn power over to B.C. for distribution, and share with the province any profits derived. B.C. Premier W.A.C. Bennett is holding out for a fixed low interest rate and a guarantee that power costs won't exceed advance estimates of four mills per kwhr.

Board Asks More Data

The B.C. Energy Board, in a preliminary report for Bennett, has recommended that ratification of the treaty be delayed. Among other things, the Board wants clarification of the amount of power B.C. load centers will get.

Other factors forming the backbone of the Board's findings included:

(1) More information is needed on engineering plans and price to consumer;

(2) Demand for power may not be as great as anticipated;

(3) No substantial export market will exist before 1970, four years after first power could be delivered from Columbia;

(4) Early treaty ratification could create an unmanageable surplus of power;

(5) Substantial cash and power penalties would be imposed if B.C.'s three Columbia dams were not completed within a specified time from ratification date;

(6) B.C. Power Commission, which would operate the Columbia project, has been asked to speed up development studies.

The report seems to dash any expectancy that the Columbia treaty will be ratified soon. In essence, it appears to warn against ratification of a treaty which would make mandatory expenditures of many millions to create return to vast quantities of downstream power to B.C. before there might be sufficient market for them.

This is perhaps the biggest doubt in the Board's mind: that there won't be a market for big blocks of power until 1970, and if the treaty were ratified this year, the first blocks of downstream benefit power would be available by 1966 (since the treaty would commit B.C. to operate High Arrow and Duncan dams by then).

What implication the report holds for the Peace River Power Development Co plan is not too clear yet, and won't be until the Columbia situation is clarified.

The Energy Board's report came on the heels of a statement in the legislature by Bennett that is compounding the confusion.

Bennett made the statement after persistent needling by the Socialist opposition in the House, so just how serious he was is anybody's guess. It stunned the legislature in any event.

"I give notice now to the federal government and everybody else that unless we get fair treatment, we will have to take over the B.C. Electric," he shouted.

The "fair treatment" was in relation to the province's share of federal tax revenues.

He said the province last year received only $350,000 as its share of special power corporation tax on the B.C. Electric and other electrical companies. (The provincial government had estimated it should have received $1.4 million.)

Meanwhile, Federal Justice Minister Davie Fulton, Canada's chief Columbia negotiator, has said he will reserve comment on the Energy Board's report until the provincial government's own attitude has been expressed.

"Premier Bennett and other members of the B.C. government made statements to the effect that as soon as a treaty was signed they would be glad to get on with the Columbia project," said Fulton, "and the treaty itself was signed with the full knowledge and consent of the B.C. government.

"I feel, therefore, that they may have been placed in a rather awkward position by the report of their Energy Board, in view of the fact that for more than two years, they had given study to this matter and had made public statements that they were fully in accord with the negotiations of the treaty and wanted to get on with the job as quickly as possible."

Senate Group Okays Columbia Treaty

The proposed US-Canadian treaty for developing the Columbia River's water and power resources was passed Mar. 15 by the Senate Foreign Relations Committee.

The Kennedy Administration is eager to seek funds to start work on a federal Libby Dam, on the Kootenai River, Mont., during the coming fiscal year.

A three-hour hearing produced favorable testimony from all quarters of the Pacific Northwest. The only obstacle to the treaty was implied in reference to problems in Canada. These problems—which could delay Canadian ratification for many months—involve objections by British Columbia Premier W. A. C. Bennett that no precise power cost figures have been developed for Canadian-generated power at the Vancouver load center.

Ivan B. White, State Department official and member of the three-man US treaty negotiating team, said, however, that quick US ratification of the treaty should "help reduce" the Canadian difficulties.

Sen Frank Lausche (D-Ohio) questioned Interior Secretary Stewart Udall on whether the treaty would require that all power generation added by the upstream Canadian storage should be generated at federal (Bonneville) dams. Udall denied this, pointing out that some of the power would be available for added generating capacity of non-federal dams. Lausche also pointed out that the treaty would add weight—even set a precedent—in the vague area of international law that nations can't upset natural water flows on international streams without legal agreement.

Federal Report Ordered on BPA Tie

The Kennedy Administration has moved quickly on a proposed federal, high-voltage (two 500-kv circuits) transmission line between Bonneville Power Administration and California. Interior Secretary Stewart Udall last week named a five-man committee, headed by Bonneville Administrator Charles F. Luce, to make a preliminary report on the line's feasibility by May 1.

"The possibility of integrating Canadian power supplies with the Pacific Northwest—Southwest intertie should be fully explored, and the plans of the British Columbia power agencies ascertained in this regard," Udall told the group. "I am specifically requesting that in making this preliminary report, the task force consult with the public and private power agencies in the areas affected, industrial customers of federal power systems, the governors of the affected states, and other interested groups."

Udall also asked the group to study the effect of oil, gas and coal —possibly for thermal generation —on the intertie. And the Secretary also cautioned that the intertie would have to produce mutual advantages to both the Pacific Northwest and the lower Pacific areas, including legal guarantees that each power-producing region would have "permanent priority" to the use of electricity generated on its own streams, if necessary.

The line would be the first major link in a federal grid inter-connecting various regional federal power systems. Its purpose, according to Udall, would be to help reduce Bonneville's annual operating deficit (predicted at $13 million this fiscal year), and to provide markets for much of the power to be made available from the proposed US-Canadian treaty to develop the Columbia River.

Pacific Gas & Electric Co had proposed its own 230-kv line, running about 100 miles between Bonneville, via California-Oregon Power Co, to PG&E's Pit No. 3 substation. The Senate Interior Committee last year blocked this plan in favor of further study on the bigger project.

California Gov Edmund G. Brown last summer hired H. Zinder & Associates (see p 58) to prepare a report on the feasibility of the big 500-kv line. Sol Schultz, Zinder manager, reported that a $200-million-plus line with two 500-kv circuits could be built connecting Bonneville, Central Valley, and eventually the Lower Colorado system (Hoover and Parker dams). Part of Zinder's feasibility, however, was based on construction of a large thermal generating station at Cle Elum, Wash., to provide firm power for delivery over the line.

The federal line envisaged by Udall would follow closely to Zinder's proposal. It would be a "common carrier" line, open to any systems who wanted to use a portion of it to wheel power.

The major problem facing federal planners will be how to give legal assurances to the Pacific Northwest that preference customers in California wouldn't have priority over Pacific Northwest users during any power shortage.

Lowe Named LBE Program Manager

Albert V. Lowe has been named manager of the Live Better Electrically Program of Edison Electric Institute, to administer the $2.5-million advertising and promotional program.

Lowe was recently vice president of Grant Advertising, Inc, supervising the International General Electric Co account. Prior to that he served as account executive with Erwin Wasey, Ruthrauff & Ryan, Inc, on the GE air conditioning account.

From 1949 to 1956 Lowe worked in various advertising and sales promotion capacities for several GE divisions.

REA Releases Cash for 50-Mw Arkansas Plant

Arkansas Electric Cooperative Corp has been given the go-ahead to construct a 50-Mw plant near Ozarks, Ark. The Rural Electrification Administration released $10,588,000 in loan funds to the co-op for construction of generation and transmission facilities to meet power requirements of REA-financed distribution cooperatives in Arkansas.

Along with the generating plant, AECC will use the funds to build 45 miles of 69-kv transmission line, and five miles of 161-kv line.

Funds released by REA were provided for in a loan approved to AECC in 1950. Release was withheld pending settlement of contract negotiations concerning power exchange between the co-op, Southwestern Power Administration, and Southwestern Electric Power Co. Issuance of a certificate of necessity by the Public Service Commission and approval by the Federal Power Commission of the interchange agreements opened the door to REA's releasing the loan.

The original plan called for construction of a 30-Mw generating plant with power provided for three distribution co-ops. But because of the interconnections, AECC is able to increase its capacity of its planned generating plant, and assume responsibility for providing power to four additional distribution co-ops. Also, wholesale power costs to the member cooperatives can be reduced.

US Files $12-Million Damage Suit

Electrical manufacturers are defendants in suits seeking damages from purchases of oil and air circuit breakers

In the first of an expected series of damage suits growing out of the electrical manufacturers antitrust case, the US government and the Tennessee Valley Authority last week filed a complaint against five circuit breaker manufacturers, asking for a maximum of almost $12 million for damages suffered on purchases of some $14 million of oil and air breakers from Jan. 1956 through Feb. 1960. In addition, the government and TVA asked that damages for another $11 million of purchases between 1951, when the conspiracy is alleged to have started, and 1956 be included in the suit when damages are computed.

TVA Files Separate Suit

In the action, the US government acted for numerous federal agencies such as the Bureau of Reclamation, the Corps of Engineers, the Bonneville Power Administration, the Southwestern Power Administration, and the Atomic Energy Commission. The TVA, considered as a corporation, filed only for its own damages. Defendants are General Electric Co, Westinghouse Electric Corp, Allis-Chalmers Manufacturing Co, Federal Pacific Electric Co, and I-T-E Circuit Breaker Co. Of these, the first three pleaded guilty in the criminal antitrust case for these products; the other two pleaded *nolo contendere*. The government's civil suit will probably be tried before a jury who will decide the total amount and the distribution of the damages awarded, if any.

The key part of the suit is the method by which the government has computed the damages. The government claims that during the four-year "computation period" for which it examined purchasing records, it found "sharp price declines, with the lowest prices having been bid . . . during the period August through mid-November 1958." Considering this period as a "base period," the government asserts that it was then that "the defendants' bids most nearly approached those prices that would have prevailed under conditions of open competition." (The complaint maintains that the manufacturers' "conspiracy" maintained breaker prices at high and artificial levels, deprived purchasers of the benefits of free competition, and denied public agencies the right to receive competitive sealed bids as required by law.)

For ten of the 40 outdoor oil breakers involved, purchases of comparable or identical breakers were made in both the "base period" and in the remainder of the four-year computation period. By comparing the successful low bids in the base period with the high prices paid in the remainder of the computation period, the government was able, according to the complaint, to establish that damages on the ten ratings, were "equivalent to 40% of the purchase price . . ." Although there were no bids in the base period on the other 30 ratings, "damages were calculated by extending the 40% result . . . from the direct comparisons in the ten breaker ratings to the prices of circuit breakers in those 30 ratings."

Using this formula, the complaint says damages sustained by TVA amount to $2,492,897, and damages to other government agencies to $2,210,686.

On the assumption that the TVA is a corporation, the suit asks triple damages—$7,478,691—for it under the Clayton Act. If the court decides that TVA is not entitled to triple damages, the complaint asks as an alternative that TVA be awarded double damages under the False Claims Act. If this is ruled out, the third alternative requested is single damages under the Clayton Act.

For damages to the US government, the suit asks double damages —$4,421,372—under the False Claims Act, or, as an alternative, single damages under the Clayton Act. The $12-million figure is obtained by adding treble damages for TVA and double damages for US government. But the total asked will probably be higher when purchases for the 1951-1956 period and for other agencies such as the International Cooperation Administration are computed and added in.

The first government suit may set the pattern of later suits on several legal issues, including length of period the claims may cover, and the size of the multiplier the TVA and the US government can use in asking damages. In addition, the court will also decide on the validity of the formula used in arriving at a damage figure, and thus probably set a precedent for later suits. But because of the docket schedule at Philadelphia the first suit will probably not come to trial for at least two years.

In a statement issued immediately after the suit was filed, General Electric said, "This government suit will, of course, be vigorously defended, since an exhaustive audit of the transactions involved is confirming that the purchasers of electrical apparatus have received fair value by any reasonable standards. Various other political agencies have announced intentions to file suits. These suits apparently will be pursued notwithstanding the General Electric announcement, on Dec. 14, 1960, of a program of voluntarily reviewing with the customers concerned as to whether they received fair value in the transactions under question. Any such suits are bound to be costly, time consuming, and highly uncertain to the plaintiffs in the light of evidence revealed by our research so far."

On its part, Westinghouse said, "The management . . . believes that its customers have not been damaged by the prices they have paid . . . and that they received full and fair value. Furthermore, price is only one factor in evaluating the worth of the equipment.

In Milwaukee, Allis-Chalmers said that an exhaustive study of their sales of the products in the original government suit convinced them that their prices were not excessive. The suit would be defended vigorously, Allis-Chalmers said.

News Scope

AROUND THE STATES — **Indiana:** House Judiciary Committee bottles up bill which would let out-of-state utilities operate in state without becoming Indiana corporations. Bill was opposed by PS of Indiana but supported by Indiana-Michigan Electric Co, which is said to be contemplating $100-million plant in Indiana. . . . **Illinois:** Bill to exempt rural electric co-ops from regulation by state Commerce Commission is introduced into House, with 57 co-sponsors. Bill is reportedly outgrowth of request by two investor-owned utilities that Commerce Commission make decision on status of co-ops. . . . **Texas:** House Committee on Revenue and Taxation reports favorably on "abandoned property" bill to require utilities to turn over to state unclaimed deposits held more than seven years. . . . Also before the legislature is a bill to impose a 1.997% gross receipts tax on utilities serving rural areas and towns under 10,000. Big city utilities already pay such a tax. . . . **Ohio:** State PUC grants Ohio Power Co request to use "flow-through" method in accounting, but defers judgment on second request that the reserve from flow-through be based on seven-year period. Ohio Power requests were made before PUC ruled on recent Cincinnati G&E case. . . . **Michigan:** Bill to prevent municipal, cooperative, or investor-owned utilities from serving other utilities customers without mutual agreement or approval by public service commission goes to state legislature. Bill was introduced on behalf of a local cooperative. . . . **Washington:** State legislature adjourns with two territory raiding bills dead in committee and Columbia compact failing to get ratification.

BIG RUSSIAN PLANT—A 2,400-Mw steam plant, comprising four 600-Mw turbines is being planned by the Russians, according to the Soviet magazine "Stojirenstvi" (Power). Each turbine will drive a "coupled pair" of 300-Mw generators. Steam conditions are said to be 4,300 psi, 1,160/1050/1,050F; over-all plant efficiency, between 40 and 43%. Fuel will be 5,300-Btu-per-lb lignite with a 35% moisture content and a 16% ash content. Each turbine set will be fed from a boiler rated 4,250,000 lb per hr. Fuel consumption is estimated at 850 to 900 tons per hr. By using cyclone firing plus a wet-type ash separator, the Soviets hope to separate 98.6% of the ash. According to Soviet calculations, the invested cost per kw of installed power will be 30 to 35% less than a 1,200-Mw plant.

Dateline . . . Washington, D. C.

(*Continued from page 5*)

Secretary Udall, we will reactivate and expand the effort of BPA to achieve maximum development of low cost Columbia River power. We will demonstrate to the world that America is still first in imagination, ambition, and determination to develop its water resources for the benefit of mankind."

But what has impressed Interior employees most has been the directive which puts the Denver planning office of the Reclamation Bureau on a 58-hour week. That says in a very direct way that the business of the "New Frontier" Administration is urgent. It says the peacetime activities are starting off at a wartime pace.

On the second objective—moves to get the anti-recession measures underway—the pattern is being set.

One top Interior official gives this thumbnail sketch of his philosophy on the anti-recession measures: "We don't expect that the federal government can pour enough dollars into the economy to get it at full steam again. We just don't have that much available from appropriations. What we do hope to do is to set a pace and inspire confidence in businessmen that the economy is moving again and they will be wise to get in the swim."

To create this atmosphere, the Interior Department is working along these lines: Directives have gone out to begin buying materials and equipment where possible in advance of need. Orders have also been issued to step up planning and designing of hydroelectric and transmission projects even to the point of hiring outside engineers to break government planning bottlenecks. Word is also out to try to get smaller projects underway where appropriations are available and plans are sufficiently advanced.

Just a notch down from the sub-cabinet level, these anti-recession measures become a bit fuzzy. They have never been very clearly defined. Thus it is possible to hear tentative suggestions that the long-proposed atomic power plant at Hanford, Wash., (price $100 million) and the gigantic California-Bonneville interconnection be advanced as just possibly fitting into this category of an anti-recession measure.

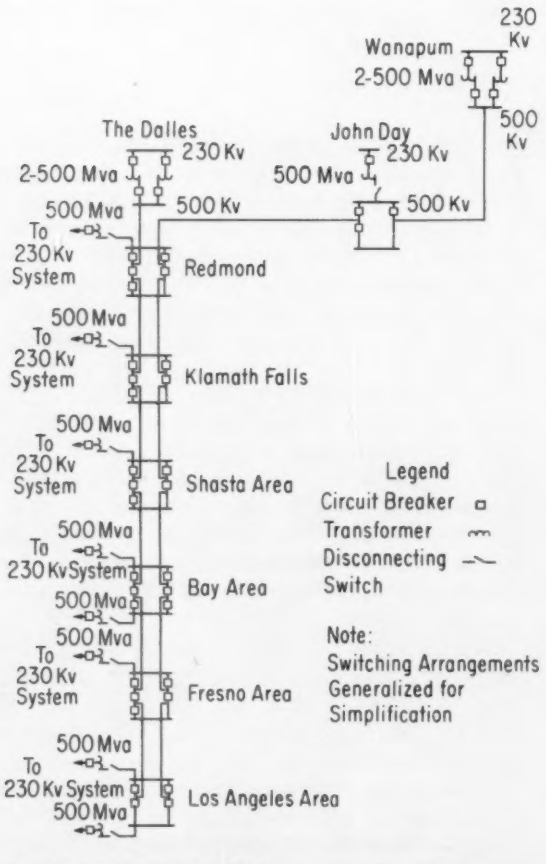
Due attention is called to the possibility that equipment for these projects might be manufactured in depressed areas, and the size of the expenditures would be of the type as to impress businessmen.

The Kennedy Administration's review of the fiscal 1962 budget is scheduled to go to Congress this week. It should disclose which of the projects, large or small, have gained admittance to the rush-rush classification.

Study 500-Kv Tie Between Columbia R.

Report says lines:

- **Would transmit over 10 billion kwhr of surplus hydroelectric energy to California**
- **Must be built soon because surplus in Pacific Northwest disappears by 1975**
- **Would cost $210 million, ¾ in lines and ¼ in substation facilities**
- **Involve 1,900 miles of single-circuit, twin-conductor 500-kv lines**
- **Tie Pacific Northwest 10.5-million-kw system to California 12.1-million-kw system**



500-KV INTERCONNECTION involves 37 500-kv circuit breakers and 13 500-Mva, 500 to 230-kv transformers

Two 500-kv transmission lines are proposed for transmitting Pacific Northwest surplus energy to load centers in California and for interconnecting the Pacific Northwest and California power systems.

The lines must be built soon since the Pacific Northwest surplus energy they are to transmit disappears by 1975 because of load growth. The $210-million project is feasible if built by a federal or non-federal public agency, or by a non-profit corporation. These are the findings of a report for the California Department of Water Resources by H. Zinder & Associates, engineers and consultants.

Pacific Gas & Electric Co, Southern California Edison Co, and Los Angeles Department of Water & Power have the major market places for Pacific Northwest power. Of the three, only the Department of Water & Power of Los Angeles had expressed a positive interest in purchasing surplus Pacific Northwest power from the proposed high capacity interconnection. PG&E had stated it would not be interested in buying power over any transmission facility which it did not own.

The report confirms the findings of an earlier report by Zinder which demonstrated that the interconnection is feasible. The principal differences are that this report: **(a)** uses more realistic estimates of loads and capacities; **(b)** considers effects of the recent US-Canadian treaty and California's water program; and **(c)** appraises benefits of coordinating Pacific Northwest operations with Central Valley and Colorado River projects.

The report concludes that:

1. There is, and will be for 15 years or more, a surplus in the Pacific Northwest of an average of 20 billion kwhr of energy each year and from 600 to 2,000 Mw of hydroelectric peaking capacity.

2. Optimum benefits could be achieved by a two-circuit, 500-kv interconnection from BPA to Southern California. This tie would have a dependable capacity of 1.6 million kw and a maximum capacity of two million kw.

3. The interconnection is definitely feasible if built by a federal or non-federal public agency, or by a non-profit corporation.

4. Firm capacity from a public power source as well as low-cost Pacific Northwest power could be delivered to California's water plan pumping plants. Also, the power from California's Oroville and Thermalito hydroelectric projects could be transmitted to points of use.

5. Integration of Central Valley and Pacific Northwest projects will increase dependable capacity of the Central Valley project.

6. The interconnection could eliminate possible firm power deficit's of Hoover Dam while Glen Canyon reservoir is being filled.

7. The tie would reduce the required reserve capacity in both areas, provide disaster and emergency assistance to both areas, and alleviate atmospheric pollution problems in California.

The report also recommends that a 300-Mw steam

and Los Angeles

power plant be built at Cle Elum, Wash., to burn low-cost coal. Then, under average water conditions, the tie could deliver to California 415 Mw of dependable hydroelectric and 300 Mw of dependable steam-electric capacity, and an average of 10.9 billion kwhr of surplus hydroelectric and 1.5 billion kwhr of firm steam-electric energy each year from 1965 through 1973.

Smaller 230-Kv Tie Included

This proposal is vastly larger and is in addition to a single-circuit, 230-kv tie proposed by Pacific Gas & Electric Co and BPA two years ago (EW, Feb. 8, 1960, p 32). The 230-kv proposal had been submitted to the Senate Interior Committee which decided to hold up approval until the 500-kv tie had been studied. With the 230-kv tie, PG&E has said it would take between 1.5 and 2-billion kwhr of dump energy annually from BPA.

Shows Pacific Northwest Surplus

The report bases its conclusions on a comparison of loads and capacities for the Pacific Northwest. Power surplus, it says, averages 2.4 million kw through 1973-74. An average of 1.4 million kw could be transmitted to California over the proposed 500-kv lines. Energy surplus is an average of 20 billion kwhr per year, and about 12 billion kwhr each year could be transmitted over the lines. Table I shows the surplus which could be transmitted to California. It decreases rapidly after 1974-75.

This is the surplus after meeting all firm and interruptible loads in the Pacific Northwest, delivering power required by the recent US-Canadian treaty, and providing a reserve of 7% of the region's peak loads. The 833-Mw electric capacity of the Hanford New Production Reactor, assumed added by 1965, is an appreciable part of the surplus.

Pacific Coast opinions of the surplus vary. Some experts suggest that some proposed Pacific Northwest hydro plants are no longer economic with Canadian storage available under the recent US-Canadian treaty and that generating capability has been stretched to the limit in the report. Others say that figures in the report check closely with other available data but that many controversial points need to be clarified. Estimates of loads for the Pacific Northwest vary considerably, ranging from a rate of growth of 4.1 to 7.2%, enough to influence the calculated surplus drastically.

Pacific Northwest Capacities Scheduled Through 1985

A capacity installation schedule for the Pacific Northwest, based on the plans of agencies and utilities in the regions, was adopted. Basically, the report assumes that all proposed Pacific Northwest hydroelectric plants, the Hanford 833-Mw generating station, and the larger of the two Snake River plants will be built.

The federal government will build, by 1979, 4.9 million kw in 22 hydroelectric projects. Also, ten

PROPOSED 500-KV LINES AND SUBSTATIONS connect low-cost Pacific Northwest energy sources to steadily growing California loads; require 1,900 miles of single-circuit line and 13 500-Mva transformers in nine substations

TABLE I—Surplus Transmitted to Calif. Decreases Very Rapidly After 1974-75

	Millions of Kw (Avg)	Billions of Kwhr
1964–65	1.330	11.651
1965–66	1.367	11.975
.....	.....	.....
1973–74	1.213	10.626
1974–75	1.077	9.425
.....	.....	.....
1979–80	0.498	4.362

TABLE II—Pacific Northwest Requires Thermal Plants After 1974-75 (Capacities in Millions of Kw)

	1964-65	1974-75	1984-85
Peaking Capability			
Hydroelectric	15.161	23.479	26.912
Thermal-electric	0.416	0.833	15.530
Total	15.577	24.312	42.442
Primary Energy			
Hydroelectric	7.849	13.282	15.172
Thermal-electric	0.375	0.750	13.977
Total	8.224	14.032	29.149
Average Year Energy			
Hydroelectric	9.872	15.202	16.868
Thermal-electric	0.375	0.750	13.977
Total	10.247	15.952	30.845

Energy values are expressed in "average kilowatts," commonly used in Pacific Northwest, equal to total kwhr over period divided by number of hours in period

TABLE III—Pacific Northwest Electric Loads Quadruple in 25 Years (Millions of Kw)

	Peak	Average
1960-61	9.889	6.844
1968-69	15.689	10.356
1977-78	26.380	17.225
1984-85	39.665	25.899

non-federal projects with a total capacity of 5.0 million kw were assumed built between 1960 and 1972. Nez Perce with a capacity of 1.2 million kw rather than High Mountain Sheep with a capacity of 875 Mw was included, beginning in 1972. Another 30 non-federal hydroelectric plants, for which definite schedules have yet to be set, are assumed installed as follows: 1.1 million kw from 1961 through 1964 and 0.8 million kw from 1971 through 1974. Changes in capacities caused by the treaty were included in the resource estimate, which is shown on Table II.

Northwest Loads Estimated Through 1985

Load estimates show a quadrupling of power from 1960 through 1985. However two important offsetting factors have occurred since these estimates were prepared. First, BPA signed contracts for 167 Mw of firm and 182 Mw of non-firm power to industrial firms. Second, the region loads are about 500 Mw less than forecasted in 1959. The 1960-69 load estimates were based on the Northwest Power Pool's 1960 report. The load beyond 1970 was extrapolated at 6.0%, higher than that used in BPA advance program and FPC reports in Feb., 1960. Table III shows the region loads.

The capacity schedule and load estimate prepared for the Pacific Northwest represents a probable relationship from which the surplus power in the area was determined.

California Capacity High on Nuclear After 1970

Early construction of hydroelectric plants may be expected by PG&E, US Bureau of Reclamation and Sacramento Municipal Utility District, each planning to install 400 Mw before 1966. However most water and irrigation projects have been scheduled after 1970.

California capacity shows an increasing proportion as possibly nuclear-fired after 1966. This nuclear category included 1.1 million kw from 1966 to 1970 and 5.8 million kw from 1971 to 1975. The California capacities were the same as BPA had used in their interconnection study in Feb., 1960, and are in Table IV.

California Loads Show Rapid Steady Growth

The California loads show a rapid and sustained growth. In the 1960's, peak loads grow about 900 Mw each year; over the entire 1960 to 1985 period, peak loads grow at an average 1.2 million kw each year. This growth makes it possible for California to absorb surplus power and energy from the Pacific Northwest without significantly disturbing present plans for generation expansion or fuel supplies. But PG&E

TABLE IV—California Capacities Become Huge Amounts by the Year 1984-85 (Millions of Kw)

	Peak	Average
1960-61	13.611	9.569
1964-65	17.571	12.469
1969-70	23.204	16.588
1974-75	30.116	21.997
1979-80	38.036	28.762
1984-85	46.075	35.673

TABLE V—California Loads Peak at 40 Million Kw in 1984-85 (Millions of Kw)

	Peak	Average
1960-61	11.544	7.469
1964-65	14.930	9.719
1969-70	20.143	13.134
1974-75	26.316	17.215
1979-80	33.191	21.737
1984-85	40.746	26.324

last fall said that importing firm power or more than 2-billion kwhr of dump energy would jeopardize water plans and hurt fuel industries. Table V shows the expected loads.

The report states that 500 kv appears most suitable for the interconnection. Other voltages were broadly analyzed but detailed economic comparisons of capital cost, transmission losses and reactive correction were not made for various 230, 345, and 500-kv systems.

Dependable power of 1.4 million kw may be required to flow over the tie, according to the report. At times, non-firm power may increase this to two million kw. However, a major conclusion is that the tie will deliver 715 Mw of dependable capacity to California.

To provide reliability for firm power delivery, two circuits are required. With one circuit out, the remaining line is able to carry one million kw. Digital computer load-flow studies satisfactorily demonstrate that one million kw can be transmitted from BPA to Los Angeles. In other studies, an additional million kw of surplus power was transmitted to northern California. Transformer capacity, estimated before the load-flow studies, may be decreased by 1 million kva after more detailed studies.

Transmission losses for the 500-kv facilities range from 5% for delivering one million kw of Pacific Northwest power to California to 10% for delivery of two million kw.

Heavy California Pumping Load Comes After 1970

The mammoth California water resources program will require seven major pumping plants with a total demand of 100 to 200 Mw in 1970 and energy requirements of 300 to 550 million kwhr in 1970. This will rise to 1,250 to 1,400 Mw of demand and 9 to 10 billion kwhr of energy in 1990. Some of this power is supplied by recovery power plants but the net load is still enormous, as shown in Table VI.

Since the state's water program requires little energy in the early 1970's, it is clear that surplus Pacific Northwest energy cannot benefit the program much.

The interconnecting and coordinating of the operation of two large power groups (Pacific Northwest 10.5 million kw and California 12.1 million kw) will produce benefits stemming from diversity of loads and capacities. Diversity between California and Pacific Northwest peak loads is estimated at 268 Mw in 1964-65, 465 Mw in 1974-75, and 833 Mw in 1984-85. These estimates are definitely conservative since they assume the two areas will experience their peak loads for each month during the same hour. This is very unlikely. Diversities in capacities, producing savings in installed and spinning reserves, could be substantial.

Line Is Financially Feasible

The report concludes the line is financially feasible. If constructed by a non-profit corporation in Oregon and Washington (5.5% revenue bonds, ten years, paying state and local but not federal taxes) and by a joint undertaking of California municipally-owned electric systems and the state of California (4.5%, ten year bonds, paying no taxes), the costs of transmission facilities are about $37.1 million each year. After ten years, the cost would decline to $5.6 million each year. Table VII shows transmission costs.

TABLE VI—California Net Pumping Load Grows Rapidly After 1970 to Huge Amounts by 1990

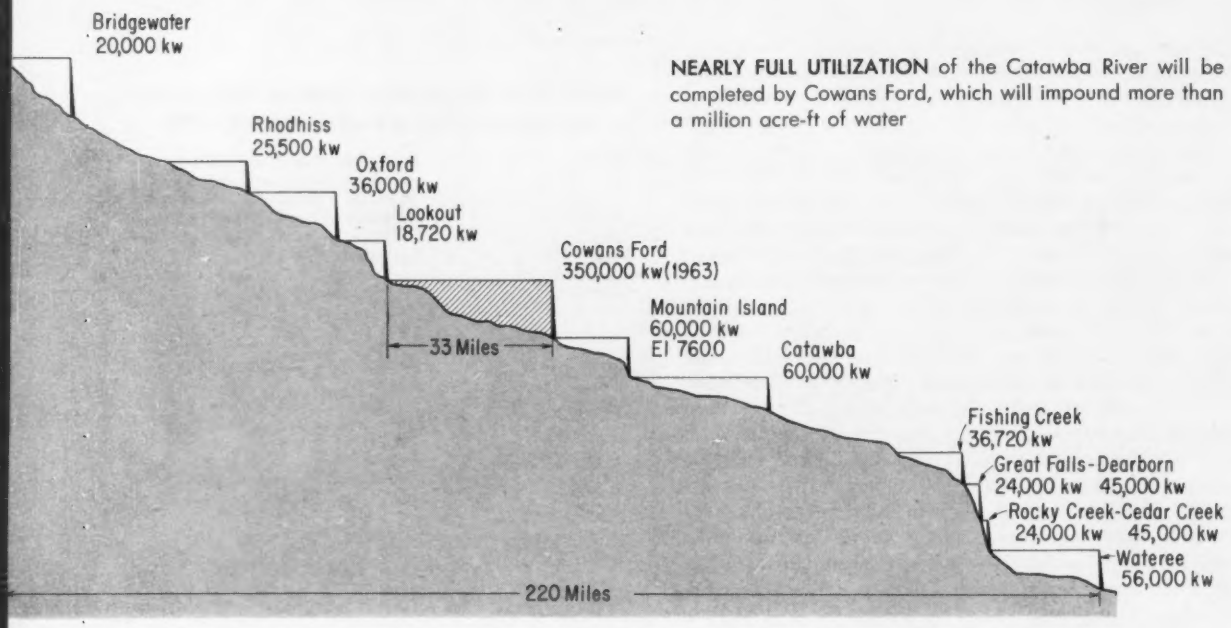
	Pumping Energy Millions of Kwhr	On-Peak Capacity Thousands of Kw	Off-Peak Capacity Thousands of Kw
1964	53	6	...
1965	61	7	...
.....	.....	.....	...
1970	506	150	89
1975	2,826	175	648
1980	4,747	598	673
1985	6,156	906	339
1990	7,566	1,253	...

The cost estimate is based on $80,000 per mile of single-circuit, twin-conductor, 500-kv line, built of conventional steel towers by conventional construction methods. Experts on the Pacific Coast feel this cost may run as high as $125,000 per mile. However, Zinder & Associates claims the estimate is based on quoted material prices with good margins for construction and right-of-way costs. In addition, recent innovations in tower materials and construction methods may lower the estimated cost.

An average of 12.1 billion kwhr is assumed available for transmission to California. After 10% losses, only 10.9 billion kwhr would be delivered through 1973-74. This energy, together with 715 Mw of firm power, is assumed to be worth $15 per kwyr plus 3.5 mills per kwhr at the point of delivery—the 500 to 230-kv substations adjacent to the 500-kv lines. The 3.5 mills assumes average alternative fuel cost of 35¢ per million Btu, equivalent to 39¢ per mcf for natural gas of 1.1 million Btu per mcf content, or $2.24 per barrel of fuel oil of 6.4 million Btu per barrel content.

TABLE VII—Cost of Proposed Interconnection Adds Up to $210 Million

Substations & Equipment	Cost (millions of dollars)	Transformers Millions of Kva
Pacific Northwest	$25.65	3.5
California	$31.70	3.0
Transmission Lines		**Miles of Line**
Pacific Northwest	$52.56	657
California	$99.04	1,238
Total	$208.95	1,895



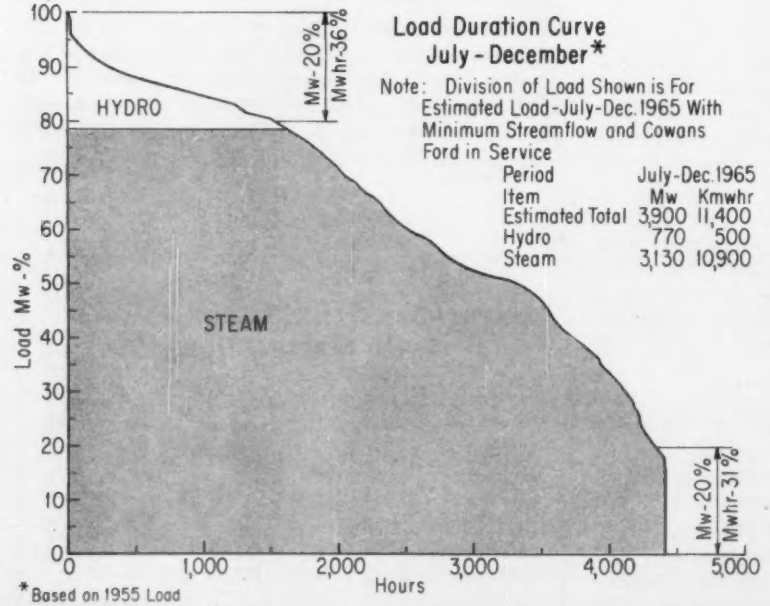
NEARLY FULL UTILIZATION of the Catawba River will be completed by Cowans Ford, which will impound more than a million acre-ft of water

350-Mw Cowans Ford Hydro Plant

Big North Carolina hydro plant will have 92-ft head. New lake's area to equal nearly total of all others on the Catawba River

J. Q. WRAY JR, Asst to the Chief Engineer, Duke Power Co, Charlotte, N. C.

Large capacity but a low load factor will be features of Cowans Ford, N. C., power plant, on which construction started last September.

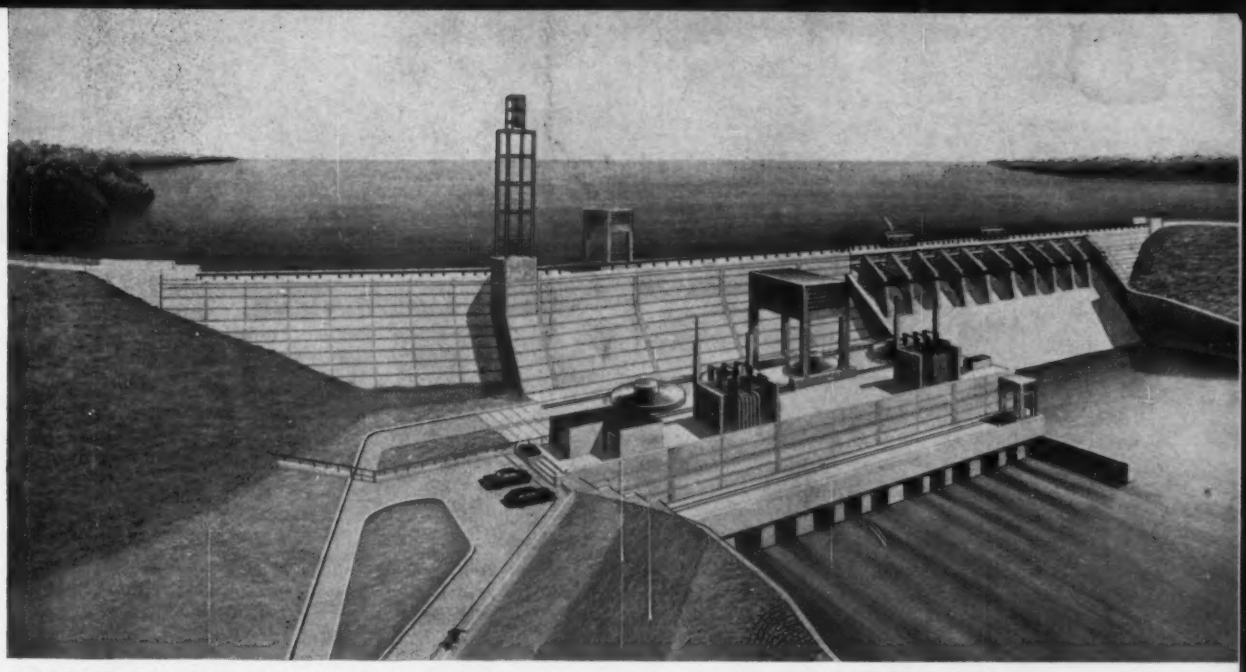


PEAKING CAPACITY in hydro contributes only a small portion of the total system energy requirements, while basic need is for continuous capacity

At 350 Mw, Cowans Ford will be one of the largest hydro plants built by an investor-owned utility. But the available water in the Catawba River will limit the load factor to about 4.5% or an average annual energy output of 140 million kwhr. The project will finish the electric-energy development of the Catawba, already among the world's most completely harnessed rivers. Each of its four umbrella-type generators will deliver 100.6 Mw. This is 15% over the 87.5-Mw nameplate value. Like the turbines, they will be only slightly smaller in physical size than the largest ever built.

So that the Cowans Ford generators can squeeze the most out of the Catawba River's potential, the dam is rising at the point of maximum backwater from the next plant downstream and will impound water up to the tailwater of the next upstream.

The development of the river started in 1900, when construction started on the Old Catawba Plant, which had a capacity of 6,600 kw. The first power from that plant was delivered in 1904 to the Victoria Cotton Mill at Rock Hill, S. C., over an 11.5-kv pole line to drive a 300-hp motor for operating the entire cotton mill. Changes in power plant operation since then



COMPLETED COWANS FORD will have exposed transformers and microwave for remote control

Will Be Peaking Station

are illustrated well by this statement in the plant log that first day:

"This being the only load, started one generator up at 6:00 am—shut it down at 6:30 pm, locked the powerhouse doors and went to bed."

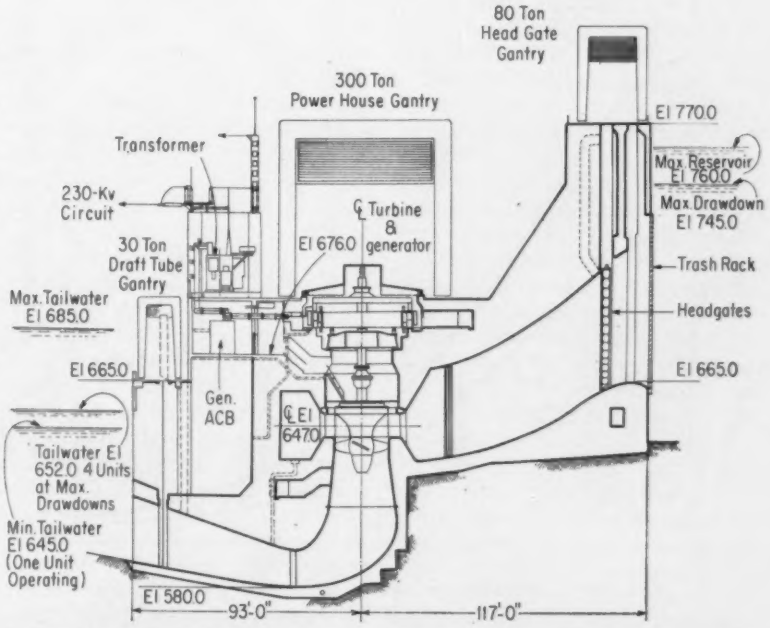
Up to now, the Cowans Ford project has not been practical because, since 1928, and especially since 1939, Duke Power Company's generation has changed from a primarily hydro system to a steam system with hydro for peaking. Earlier development here, in spite of the size of the Cowans Ford plant, would have been of little value in meeting the large demand for energy during those transition years because of the plant's low load factor. Generating capacity on the system has been about 80% steam and 20% hydro in recent years, with the hydro plants accounting for only 3.6% of the total energy output in a typical 6-month period. Cowans Ford will maintain this ratio on the system, which will have an estimated peak load of 3,900 Mw in 1965, when the fourth generator goes in here. Construction of the dam and first three units is due for completion in 1965. The ultimate cost will be $62 million, $4 million of it for relocation of highways and other utility installations.

The 13.8-kv generators will be covered by removable hatches, which will lie exposed to the weather rather than enclosed in a building. The outside diameter of the stators will be 34 ft 7 in. and each rotor and shaft will weigh 700,000 lb.

The 110-in.-dia, Kingsbury-type thrust bearing will carry a combined weight of 3,215,000 lb. The unit will be arranged for motoring to furnish reactive.

A 300-ton gantry crane will

(*Continued on page* 110)



TURBINE WITH SIX BLADES will turn out 121,000 hp at 105.9 rpm. This will have the highest head of any Kaplan turbine in the country

New Lightning Flashover Theory

New explanation of lightning flashover may indicate why transmission line performance has not met design standards

S. B. GRISCOM, Advisory Engineer, Electric Utility Engineering Dept, Westinghouse Electric Corp, East Pittsburgh, Pa.

The 60-cycle power voltage is sufficient to cause transmission line flashover in cases where lightning has reduced the electric strength of the air in the vicinity of the towers. Briefly, this type of flashover is produced by induced voltage, and not caused by a direct stroke to either the tower or the phase conductor. A theory only, this type of flashover could explain the failure of some transmission lines to meet expected design standards.

Transmission line flashovers from lightning are generally regarded to be the result of one or the other of two basic mechanisms, or modes:

Mode 1: The lightning stroke terminates on the steel tower or ground wire. The tower top potential then rises with respect to that of the power conductors because of tower footing resistance, inductive drop in the tower, and the electric field changes associated with the stroke. If there is a sufficiently great difference of potential, a flashover occurs. Such flashovers are also called "back-flashes."

Mode 2: The lightning stroke terminates on a power conductor raising it in potential with respect to the tower. Flashover is practically certain, and such flashovers have been termed "side-flashes" or "shielding failures." These are usually ascribed to failures of the ground wire system to shield the power conductors.

By following construction principles laid down about 30 years ago, with regard to shielding with overhead ground wires and getting low tower footing resistances, transmission line tripouts from lightning have been reduced to a rate of the order of 1/30 that prevailed before the direct stroke theory. Thus, the essential soundness of Modes 1 and 2 is well established and accepted by the industry.

Despite this excellent record, there are many instances of poor performance where line designs met the requirements for minimizing Mode 1 and 2 flashovers. Such examples indicate the possibilities that the available data on lightning stroke characteristics are inadequate, performance calculation methods need improvement, and possibly that there are other flashover modes.

Mode 3: Prestrike theory predicted that the lightning stroke current wave form was more complicated than had been previously considered. Under it, high tower-top potentials might occur, even with perfect shielding and low tower footing resistance. This is a Mode 1 or back-flash type of flashover. But since it is caused by a different set of circumstances, and is improvable by different means, it will here be called a Mode 3 flashover.

Field tests are being conducted with kine-klydonographs by the American Electric Power Co, Commonwealth Edison Co, Ohio Edison Co, and West Penn Power Co, jointly with Westinghouse Electric Corp, to get data on the rise time of lightning stroke currents. So far, only three records have been obtained during this program. This is an insufficient number for statistical evaluation.

The work of Schonland, about 25 years ago, showed that a lightning stroke is initiated by a down-

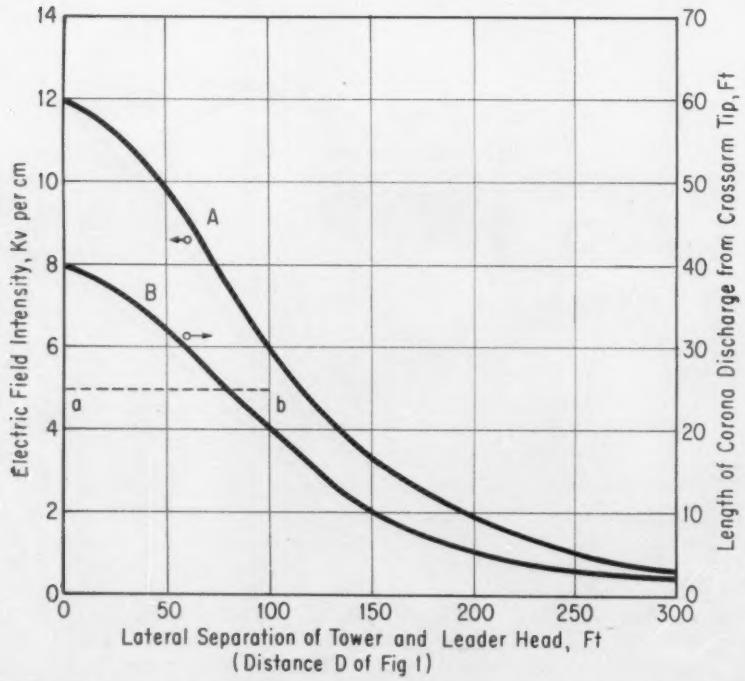


FIG 2—ELECTRIC FIELD INTENSITY (A) around tower increases as head nears tower, causing tower corona discharges (B) longer than the insulator string

Proposed

ward "leader stroke" which proceeds by steps about 75 ft long and has pause times of about 50 microseconds. This work also considered that the cross-section of the leader was fairly uniform along its length including its tip, the current flow was relatively steady, and that charge was lowered at a uniform rate, despite the steps observed photographically.

Prestrike theory, on the other hand, predicted that the tip or head of the initial leader was physically large, contained a much higher charge per unit length than the rest of the leader, and the steps were accompanied by large pulsations of current in the leader core. The events just prior to contact between the leader head and ground according to the prestrike theory are shown in Fig 1, alongside a 100-ft tower for comparison. Diameters of the envelopes of charged ions about the leader channel and leader head are shown according to their calculated relative diameters. Both envelopes are more or less figures of revolution about a small, about ⅛-in.-dia, highly-ionized leader core.

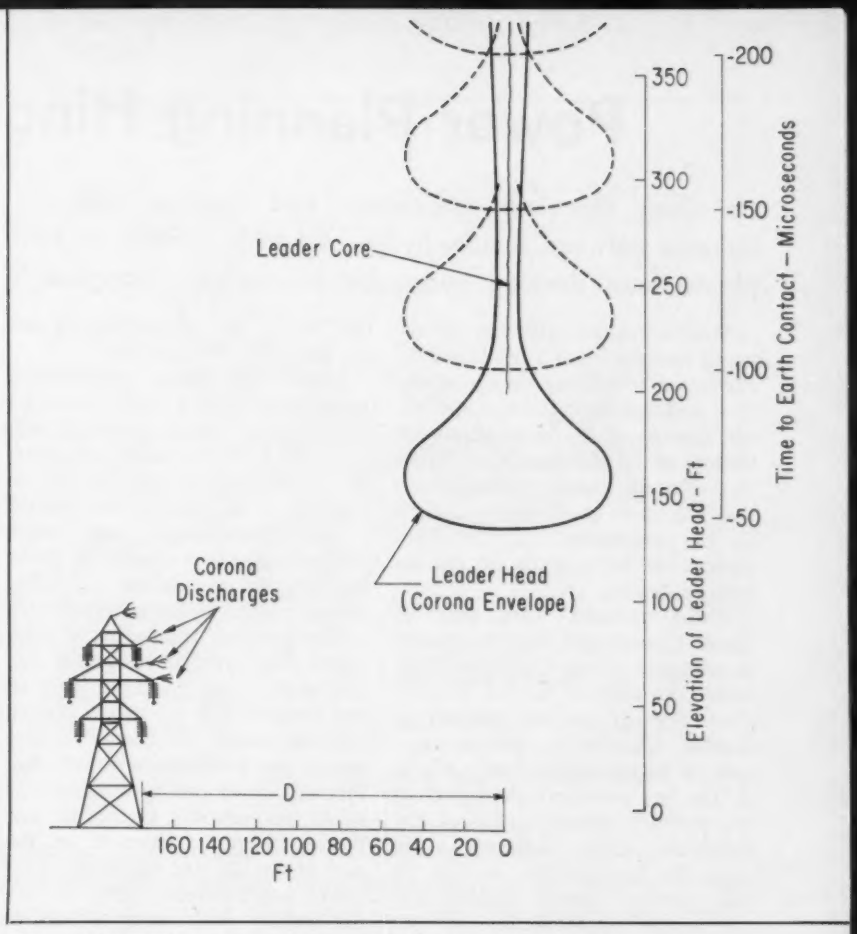


FIG 1—**LIGHTNING** consists of large, highly-charged leader head with lower charged core; steps are accompanied by large pulsations of current in core

Significance of a large leader head lies in the high electric field intensities produced at locations up to several hundred feet distant. In Fig 2, A is a plot of the calculated field intensity at 100 ft elevation against lateral displacement from a leader head poised at 150 ft elevation as in Fig 1, and charged to 50 million volts. The field intensity is that which would exist in the absence of any conducting grounded objects such as towers and power line conductors. When such objects are present, electric fields in their vicinity are greatly distorted and intensified. This is particularly so if the tower is high, and especially true with respect to the tips of crossarms where the insulators are attached.

Computation of the electric field intensification about a tower and transmission line is exceedingly complex and time consuming. Fortunately, such calculations are not necessary, because if corona discharges occur, clouds of space charge, ionized air, will surround the cross-arm tip, and intercept the electric field force lines from the leader head.

An approximate relation, available for determining the radius of such corona discharges, gives the results which are plotted as B in Fig 2. It will be observed that the corona discharges will be quite long if the stroke is close to the tower, being more than commensurate with the length of an insulator string.

Actually, the electric field intensities are so large for distances under about 80 ft, the corona discharges are expected to consolidate in a leader spark type of discharge, and continue to lengthen. This zone is roughly bounded by the dashed line a-b. The practical significance of this line is that a leader headed for ground would be attracted to the leader from the tower, and would make the necessary sharp change in direction.

Mode 4: With the points of view brought out by Figs 1 and 2, the fourth mode may now be stated: A nearby downward leader, with a highly charged leader head draws corona discharges from the cross-arm tips, insulator string and power conductor, reducing the electrical strength of the air in those zones. The 60-cycle power voltage is then sufficient to cause flashover. In short, Mode 4 flashover is induced, and not caused by contact of the stroke with either the tower or the phase conductor.

At the present time Mode 4 is a theory only. Consideration of its possibility could lead to discovery by close examination of the terrain within a 300-ft radius, when flashovers have occurred, but where magnetic link or other data indicate that no direct contact took place.

Power Planning Hinges on Natural

Canadian Electrical Association told decade calls for balance between remote hydro and local nuclear or coal plants; must develop hydro before nuclear undercuts it

More conscious planning of national resources and a dispassionate evaluation of remote hydro vs nuclear and coal-fired thermal stations will emerge as the most important features of the decade. It will bring consolidation and co-ordination with immense developments based on the conviction that the right choices are being made for the industry's future.

These remarks were part of David Cass-Beggs' keynote speech to delegates of the Canadian Electrical Association at its Eastern Zone meeting late last January at Halifax. Cass-Beggs, general manager of Saskatchewan Power Corp, is "the first president of CEA from the publicly owned sector of the Canadian utility industry." He cited the association's decision to give publicly owned utilities full and equal representation as "an action fully in line with Canadian traditions," enabling it to speak nationally for the whole electrical supply industry.

Coast-to-coast transmission may be the logical next step, he said. Among its advantages would be improvement of load factor through pooling the time zones and tapping undeveloped hydro resources of British Columbia, Manitoba, Quebec and Labrador as well as low-cost fuel in Alberta and Saskatchewan. Such a project calls for careful evaluation of the needs and plans of investor-owned and publicly owned utilities, consideration of dc as well as ac transmission, and recognition of provincial and federal responsibilities.

"Sooner or later hydro and nuclear costs will cross over and no more hydro will be built," Cass-Beggs continued. "This leaves us 20 or 30 years to complete the development of our hydro resources." Conceding that hydro developed during this interval will not be rendered obsolete, he nonetheless saw in this race "a new urgency on the development of the Columbia, the Peace, the Saskatchewan, the Nelson, the Manicouagan, and the Hamilton in Labrador."

Generating plant construction during the decade will reach 20 million kw, Cass-Beggs predicted, at a cost of $800 million per year. He urged federal help in this financing at an interest rate related to government borrowings "without seeking either control or profit through the transactions . . . The sale of surplus hydro energy [to US utilities] would enable us to push ahead with hydro development . . . and pay for a significant part of our investment in the export period, with the result that energy for domestic use would be at lower cost. Properly developed agreements . . . could not possibly create an embarrassing vested interest on the part of the US, and importing companies could develop plans . . . for the orderly replacement of Canadian exports."

Interconnection Aids 4 Utilities

The new Maritime Interprovincial Interconnection, cited by CEA's president as a step toward coast-to-coast transmission, was covered in a symposium by F. C. MacLoon, New Brunswick Electric Power Commission; L. B. Murphy, Nova Scotia Power Commission, and D. K. Teasdale, Nova Scotia Light & Power Co. According to their papers, this interconnection comprises 67 miles of 138-kv steel-tower line from NBEPC's existing system at Moncton to Canada Electric Co's steam plant at Maccan where it joins NSPC's existing wood-pole line, converted from 69 to 138 kv as contemplated in design. At Onslow, 53 miles down the wood-pole line, it ties to the major portion of NSPC's grid and to NSL&P Co, although each utility had to build additional 138-kv lines into its service area. NSPC did this by converting the 37-mile, 69-kv, wood-pole, Onslow-Trenton line to 138-kv while NSL&P built 56 miles of 138-kv steel-tower line from Onslow to the Halifax area.

This interconnection, rated at 100 Mw, is expected to bring substantial economies in sharing reserve generation at 12% of peak load instead of 30 to 40% to back up the largest units on each individual utility. Energy interchanges will be negotiated between utilities on an incremental cost basis. And future generation may be in large units installed jointly by the three participants when their load outgrows the existing 303 Mw of hydro and 385 Mw of thermal generation, they suggested.

Weigh Tidal Power

Tidal power from the Bay of Fundy remains a "challenge," said M. W. Trenholm, Nova Scotia Power Commission. Minas Basin offers the greatest potential "but economical development is contingent upon a much greater load than presently exists. As a second choice, Shepody-Cumberland is very attractive" and could developed in easy stages to an ultimate of 1,800 Mw. For an interim 400-Mw installation, Trenholm estimated that $206-million investment could produce 137.5 Mw of firm generation and over 2 billion kwhr per year at 7 mills.

Fossil-fuel generation will increase more rapidly than hydro, reaching about 33% of Canada's total generation by 1981, predicted C. E. Baltzer, Dept of Mines and Technical Surveys. Utilities will need greater amounts of reliable energy which can be produced more economically in thermal than in hydro plants. Coal consumption will double in seven years as utility plants reverse their current swing to gas in western Canada and put more of their base load on steam. "It behooves the [coal] supplier and the utility to mutually assess . . . and integrate viewpoints," he urged.

The question was raised, in discussion, whether utilities have a responsibility to bolster their service areas' economies by burning local fuel. But A. R. Harrington, Nova Scotia L&P, pleaded for help in avoiding emotional pressure on utility engineers to sacrifice system efficiencies for the sake of more fuel consumption.

Resources

Meanwhile Ontario Hydro, despite its marked swing to coal fired generation, is developing 528 Mw in hydro sites far north of its load center. Their output will be transmitted via a new 460-kv line 230 miles to the existing grid at Sudbury. Design and construction methods for this line, said Maurice Markowsky, have been tailored to muskeg conditions for the northernmost 90 miles (EW, Feb. 20, p 36) and to a scarcity of transport routes for heavy materials.

During the first ten years, the single 460-kv line must be maintained by live-line methods to minimize outages, added T. J. Burgess. Tests at Coldwater show that men in wire-mesh, conducting clothes can work safely on grounded ladders or platforms 12 ft or more from energized conductors on steel towers. A trailing wire grounding this clothing permits similar work on wood structures. Damaged insulators in 460-kv suspension strings will be replaced as easily as at 230 kv. And units in the 4-string strain assemblies are readily changed as long as the yokes can be swiveled to put the damaged string at the top, he said.

MARITIME INTERPROVINCIAL INTERCONNECTION brings economy to four utilities, sets up systems for joint use of large generating units or tidal projects

Promotes U/G Residential System

Distribution sessions revealed high interest in residential underground developments. B. D. Fleming, Toronto Township Hydro Electric Commission, keynoted the interest, saying:

"We can sell many subdividers on the immensely improved aesthetic qualities. It upgrades the value of their homes . . . [and] people are prepared to pay for it. Sooner or later it will be our standard method in urban and suburban areas."

Fleming then presented his commission's program for combining the promotion of Gold Medallion homes and underground distribution. This program calls for an assessment on the subdivider of $260 to $295 per home, depending upon number of homes and average lot width, plus an additional charge for connecting services after the builder trenches in cables provided by the utility. But wherever 50% or more of the homes are built with electric heating, the builder and the subdivider divide rebates totaling $220 per Gold Medallion home, $200 per Bronze Medallion home with total electric heating, $150 per non-Medallion home with electric heat, and $50 for a straight Bronze Medallion home. Revenue from such plans is expected to show a profit for the commission of 19 to 27%.

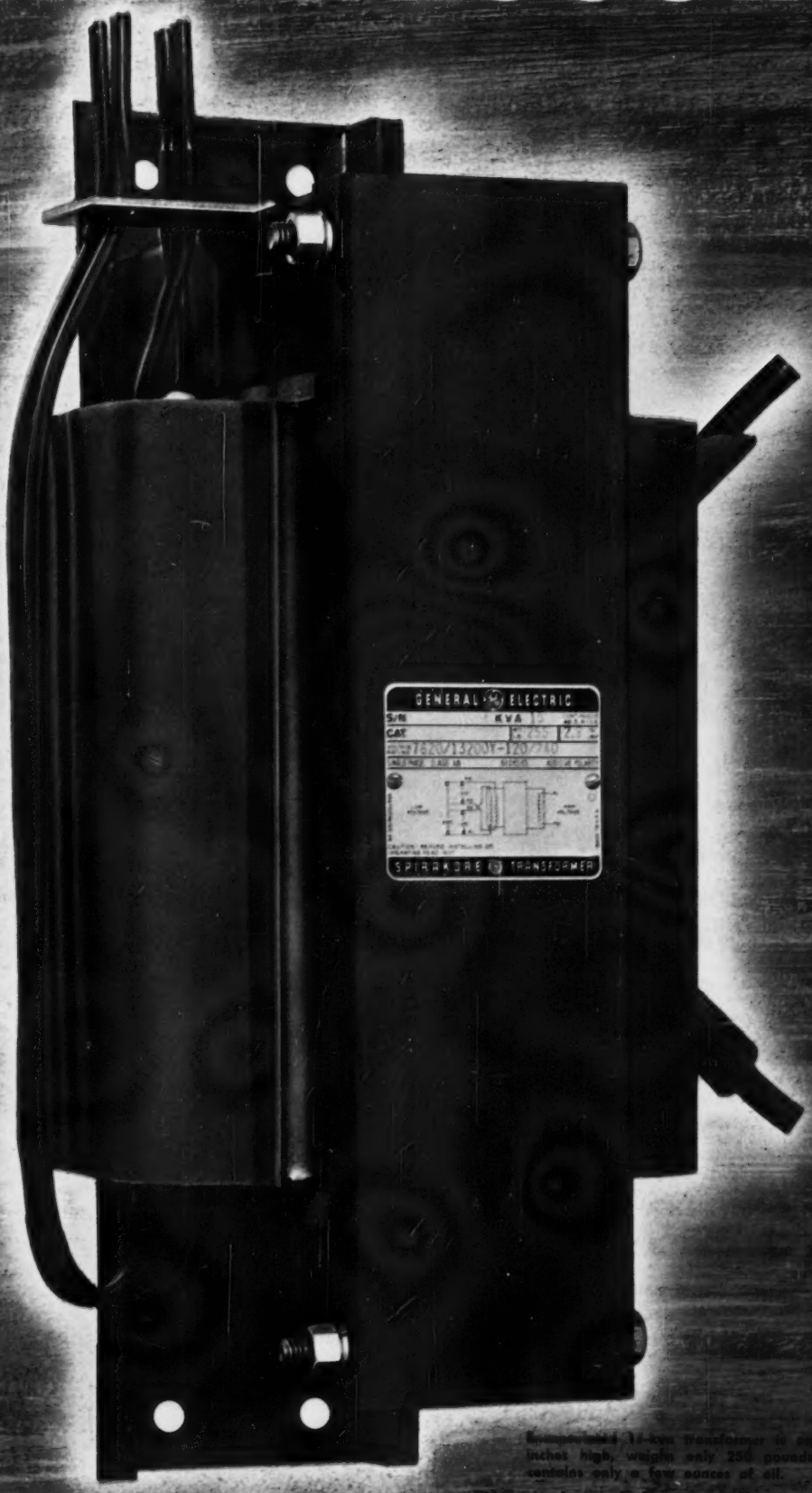
Designs and cost estimates for this program were taken from experience dating back to 1954 when the commission started a buried-cable system to serve 300 homes, Fleming explained. Trouble at an increasing rate spurred complete rebuilding to more rigid specifications in 1960. The new specifications provide a duct and a spare, currently 3-in. polyethylene pipe for PVC-jacketed, copper-shielded, polyethylene-insulated primary cable. The ducts are backfilled with 3 in. of stone-free sand. Transformers and cutouts are in pad-mounted metal cubicles which also house terminals for the polyethylene-insulated No. 2 aluminum service cables which are direct-buried. Secondary mains, where needed, would be polyethylene-insulated aluminum buried in sand 3 in. above any primary duct.

A new development of 423 homes ranging from $18,000 to $50,000 on 75 x 140-ft lots near London, Ontario, will be served by Ontario Hydro's first major residential underground distribution system, reported C. J. Moull. Distribution investment has run about 2⅓ times normal overhead costs, this additional cost being included in the price of each lot. Rebates provide $100 for a Gold Medallion installation including range, dryer and water heater, $50 for a Branze Medallion home with any two of these major appliances, and an additional $100 to either for electric house heating.

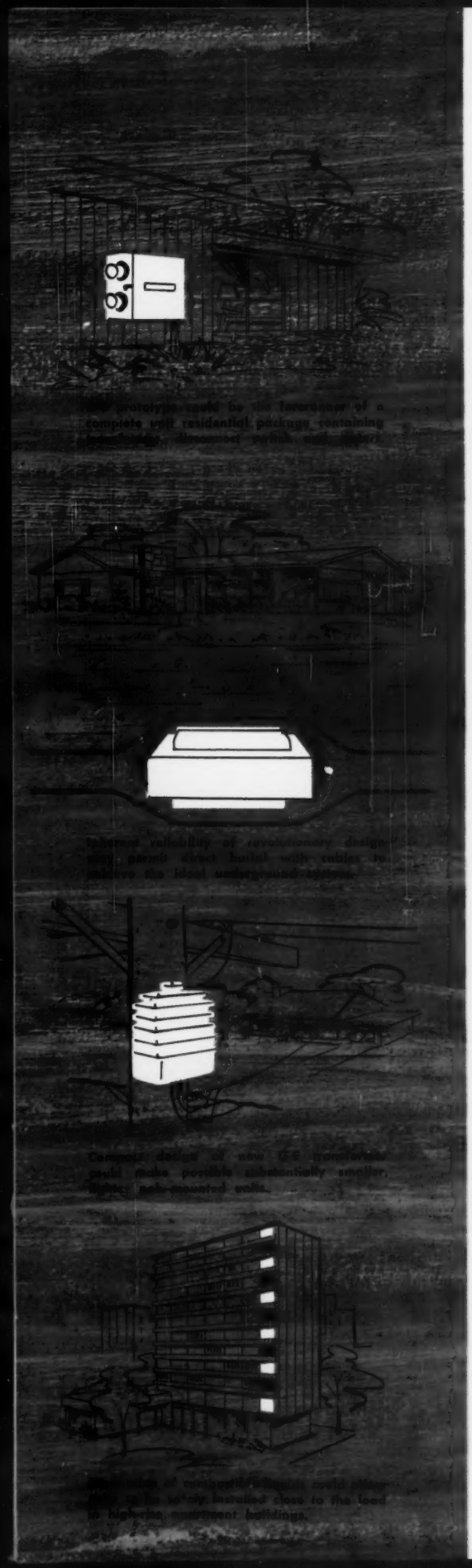
Cables are direct-buried under sand in 36-in. trenches under rear-lot easements, with thick-wall fiber duct at road crossings and in sections where future primaries are planned, Moull continued. Protecting blocks are provided where only

(*Continued on page* 108)

BREAKTHROUGH!



Encapsulated 15-kva Transformer is only 26 inches high, weighs only 250 pounds and contains only a few ounces of oil.



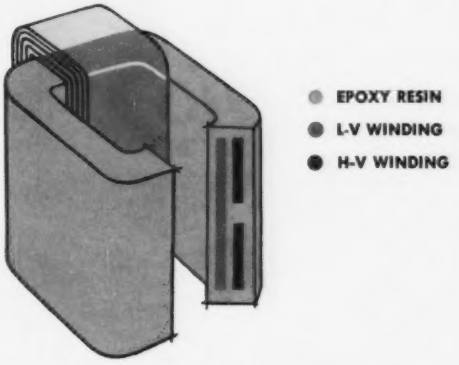
General Electric reports on one of the most important distribution transformer developments in 75 years

Take a close look at *this* distribution transformer . . . it's the first not to use oil for insulation and cooling since Elihu Thomson applied for patent on his oil-filled design in 1886!

It's General Electric's revolutionary new *encapsulated 95-kv BIL transformer*. And though still developmental, it promises important new advantages to help utilities meet the high-load demands of the decade ahead.

The keys to this dramatic innovation are a special epoxy resin and advanced methods of encapsulation that provide high dielectric strength and efficient heat dissipation. Transformer tank, paper layer insulation and all but a thin film of oil around the windings have been eliminated. Result: a distribution transformer 25 percent smaller and significantly lighter than present-day designs—and vastly more versatile. A few of its possible future applications are suggested at the left. There are many more—some as yet undreamed of!

Extensive research and application development are now underway to explore ways in which this important innovation might best be exploited to your full advantage. Such research typifies the unseen *extra* value you get when you specify General Electric—*pioneer of new ideas in power distribution!* General Electric Company, Schenectady 5, N. Y. 482-22



Progress Is Our Most Important Product

GENERAL ELECTRIC

Tailor Surge Protection Curves for Switchgear

A. H. KNABLE, General Engineer, Switchgear Dept, Allis-Chalmers Mfg Co, Milwaukee, Wis.

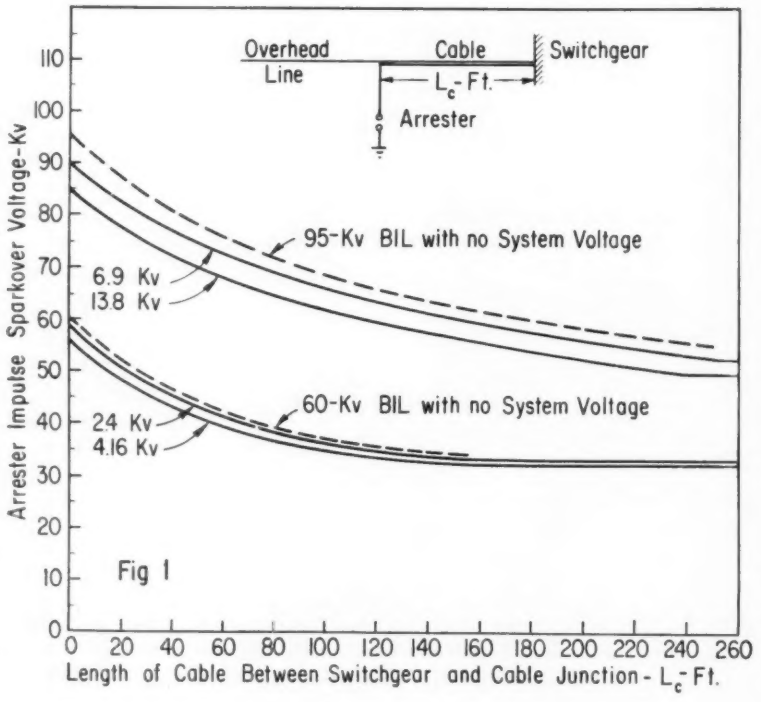

Overhead Line
Cable
Switchgear
L_c - Ft.
Arrester
95-Kv BIL with no System Voltage
6.9 Kv
13.8 Kv
60-Kv BIL with no System Voltage
24 Kv
4.16 Kv
Arrester Impulse Sparkover Voltage-Kv
Length of Cable Between Switchgear and Cable Junction - L_c - Ft.
0 10 20 30 40 50 60 70 80 90 100 110
0 20 40 60 80 100 120 140 160 180 200 220 240 260

Fig 1

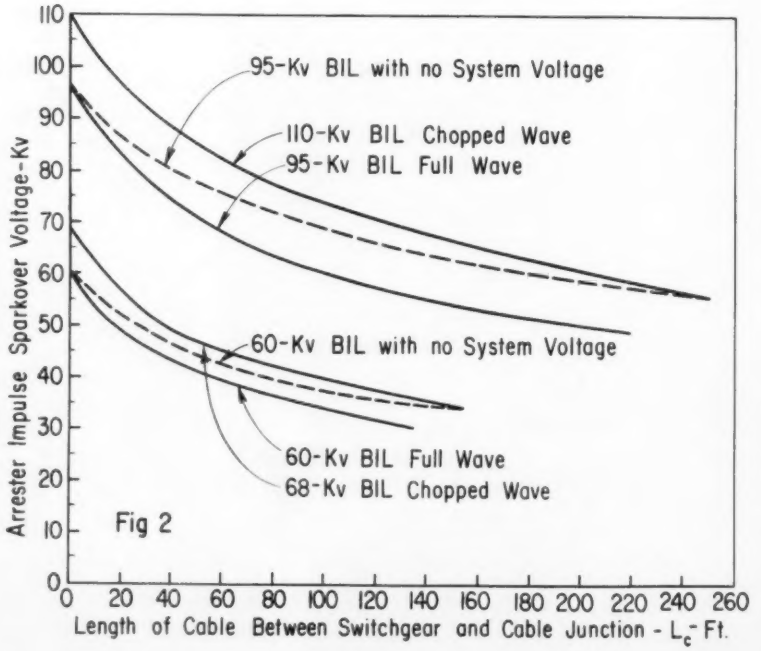

95-Kv BIL with no System Voltage
110-Kv BIL Chopped Wave
95-Kv BIL Full Wave
60-Kv BIL with no System Voltage
60-Kv BIL Full Wave
68-Kv BIL Chopped Wave
Arrester Impulse Sparkover Voltage-Kv
Length of Cable Between Switchgear and Cable Junction - L_c - Ft.
0 10 20 30 40 50 60 70 80 90 100 110
0 20 40 60 80 100 120 140 160 180 200 220 240 260

Fig 2

Tailored curves showing the needed surge protection for 5-kv and 15-kv metalclad switchgear can be developed from generalized curves dealing with protection of equipment with remotely located lightning arresters. This article illustrates the establishment of more specific information from such generalized curves (A. H. Knable, AIEE 58-69, April, 1959).

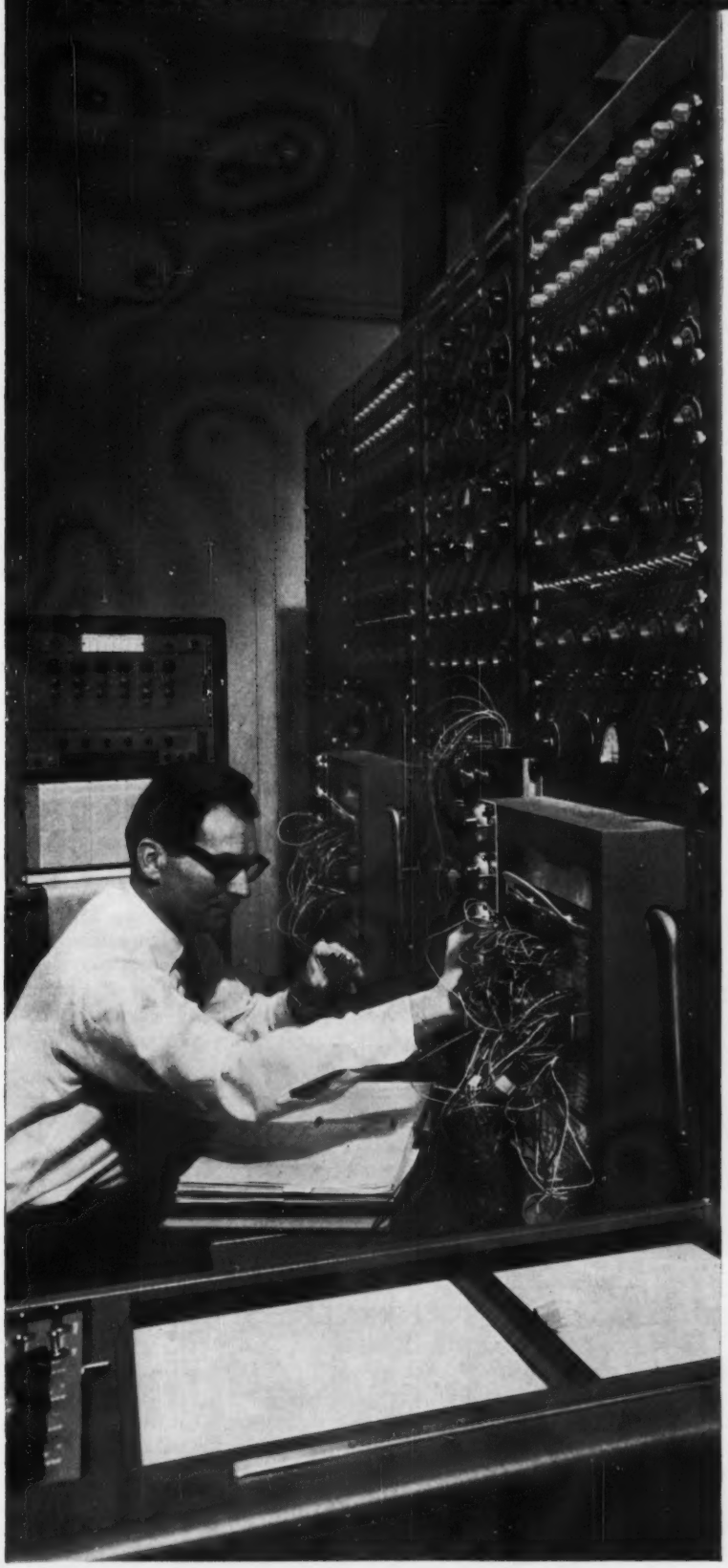
For this example, lightning strokes with 500-kv per μsec rate-of-rise are appropriate. The cables involved have a 30-ohm surge impedance. From Fig 3, 6, and 7 in the reference paper, data for 5-kv and 15-kv class switchgear can be plotted (Fig 1). These curves relate the maximum permissible cable length and arrester sparkover voltage with the system voltage.

Both full-wave and chopped-wave impulse level data are considered to account for the short-time characteristics of the switchgear insulation. By considering two limiting conditions of the insulation (full wave and chopped wave), the always elusive effect of wave shape can be approached with fair accuracy and minimum effort for the simple radial system under consideration.

When an arrester is mounted at the equipment (0 ft between equipment and arrester), the wave is essentially a full wave and the full-wave BIL characteristic is the starting point. When the arrester is remote from the equipment (at a distance sufficient to just double the surge voltage), the wave is oscillatory with short-duration peaks and the chopped-wave BIL characteristic is used as the end point.

Chopped-wave and full-wave BIL curves for the 5-kv and 15-kv class switchgear are plotted in Fig 2. These curves present the limits between which the short-time characteristics of the switchgear insulation are established. The shape of these curves will aid in tracing in the solid contour of the "no system voltage" working curve with reasonable accuracy. In Fig 1 the application curves for a given system voltage are below the "no system voltage" curves so that compensation for the system 60-cps voltage is made.

ANOTHER STEP AHEAD IN VOLTAGE REGULATION



COMPUTER STUDIES BY GENERAL ELECTRIC PROVE . . .

Reduced Regulator Bandwidths Increase System Earnings

General Electric voltage regulators provide three added benefits to distribution systems through bandwidth reduction . . . extra feeder length, capacity, and revenue! New General Electric computer studies now prove that *reduced regulator bandwidths are practical* and that they result in increased distribution system performance with *no sacrifice of regulator life.*

Electric utilities have long recognized the desirability of bandwidths as low as ±¾ volts. The assumed stumbling block was the number of regulator operations. Through analysis of actual (as opposed to theoretical) data, new General Electric computer studies indicate that bandwidths of ±¾ volts are feasible from any standpoint, including that of equipment life.

Your General Electric regulator representative can show you the specific effects on regulator operation as bandwidths are reduced. He will show you how to determine if operations must be controlled . . . and if so, how to control them. Increase the return on your regulator investment, possibly with your existing equipment.

Take full advantage of the important benefits of General Electric ML-32 step regulators. Reduced bandwidths provide more *usable* kva on the line . . . permit increased loading of existing feeders. This easily attainable "power adder" can mean increased line length and capacity—important tools to reduce or defer investment. Reduced bandwidth settings make significant contributions to feeder revenue, too!

And contact your General Electric sales engineer for even more reasons why General Electric regulators cost less on the line! General Electric Company, Schenectady 5, N. Y. 456-02

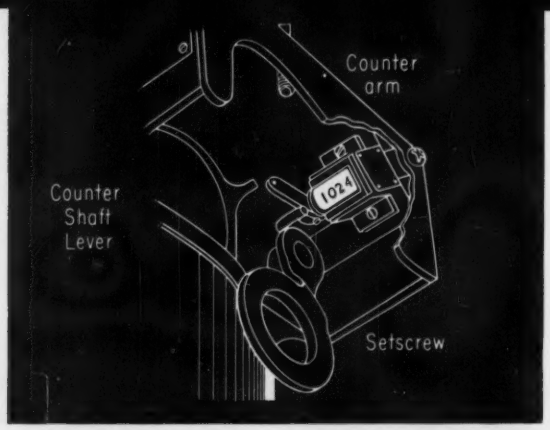
Progress Is Our Most Important Product

GENERAL ELECTRIC

ELECTRIC UTILITY METHODS

E u m

MAINTENANCE & OPERATIONS



MIRROR reflects sunlight into sleet hood to counter dial

Binoculars Aid in Field Inspections

H. C. BREEDING, Electrical Engineer, **R. R. GREGORY**, Lineman, Appalachian Power Co, Abingdon, Va. —AEP System

There are many advantages to using binoculars for visual observation, to aid in surveying, and to make special inspections. They save time, prevent eyestrain, improve coordination of teams in the field, and also contribute to safety. Among the many uses for binoculars in field work, they are helpful in making inspections of hardware mounted near pole top or on crossarms. Also with the aid of a small mirror to direct light under the recloser sleet hood, we have even been able to read the recloser counter dial from the ground.

To read the recloser counter dial from the ground, we must use either a mirror or a spotlight —some source of light is needed because of the sleet hood that covers the counter dial. A mirror placed on tripod (or other support) reflects sunlight into the sleet hood so that counter dial can be read from ground with aid of binoculars. One man can take counter readings, list pole number and fuse tab information, and observe any unsafe conditions—without climbing a pole.

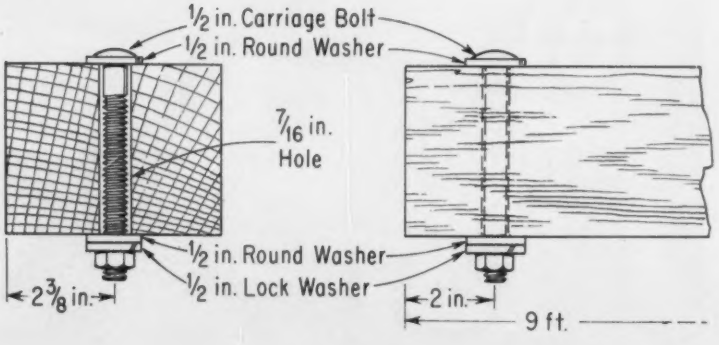
Binoculars are particularly helpful for checking recloser operations when there is suspicion of possible lack of coordination. They are helpful for inspecting contractors' work, where looking at connections and risers from the ground can be difficult.

In some cases, it is necessary to climb the pole to make an adequate inspection; especially during the regularly required inspections of reclosers for broken bushings, and inoperative counters. A cautionary note—binoculars have a way of disappearing, especially when left on the seat of an unlocked vehicle.

Bolts Prevent Splitting of Arms

Carolina Power & Light Co is solving the problem of splitting of distribution crossarms by installing ½-in. carriage bolts 2 in. from the ends of the arms. The practice has been applied to 3¼ in. x 4¼ in. x 8 ft arms and to 3¾ in. x 4¾ in. x 9 ft arms.

This is the same corrective measure that has proved so successful in the past with transmission crossarms.



INSIDE
THIS
HIGH-VOLTAGE
CURRENT-
LIMITING
FUSE...

Damaging currents are choked out in ½ cycle

Inside General Electric high-voltage current-limiting fuses, damaging short circuits are limited to harmless levels and choked out in ½ cycle or less to prevent damage to protected equipment.

When short circuits reach a value and duration great enough to melt the fuse element, resistance increases immediately on the rising portion of the current wave. Complete interruption occurs at the first voltage zero after melting—or within approximately one-half cycle—without discharge or noise.

General Electric high-voltage current-limiting fuses are sure to meet your application requirements—indoors or outdoors—for protection of capacitors, motors, transformers, load centers, feeder circuits, and for general purpose duty. They're available in all standard voltage ratings from 600 to 34,500; and in a range of amperage ratings designed to meet any need.

Want more information? Contact your General Electric apparatus sales representative. Or write to Section 497-01, General Electric Co., Schenectady 5, New York.

GENERAL ELECTRIC

CLAMP

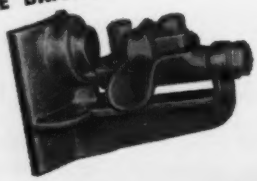
THE LAPP CLAMP IS INTERCHANGEABLE

Five sizes of clamps, in aluminum or malleable, each with reversible keeper, provide correct fit for all conductor sizes .25" to 2.00" dia. All clamps are interchangeable for use on

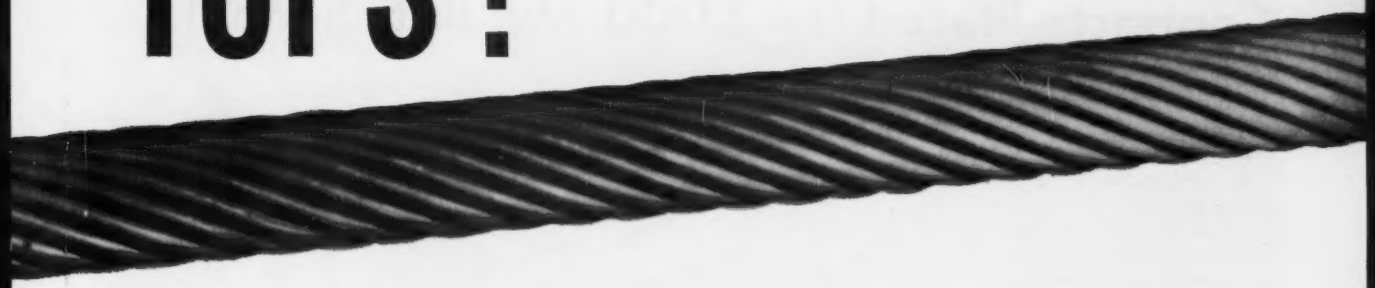
CLAMP-TOP LINE POSTS . . .

CLAMP-TOP LINE POSTS WITH INTEGRAL BASE-AND-GAIN FOR ARMLESS CONSTRUCTION . . .

CLAMP-TOP GROUND-WIRE BRACKETS



-TOPS?



THE LAPP CLAMP IS EASIEST TO INSTALL

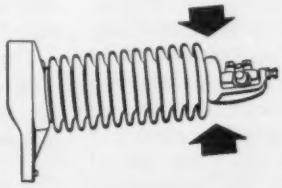
For original installation, insulator (or bracket) with clamp attached, is mounted to crossarm or pole. Keeper cap screws are loosened, and one removed. With keeper rotated out of position on remaining cap screw, conductor is dropped into place. Keeper is brought back to position, cap screw replaced, and both cap screws tightened. Cap screws have captive lock-washers so there is *only one loose part* per insulator throughout installation.

THE LAPP CLAMP IS EASIEST TO WORK WITH HOT-LINE TOOLS

No special tools required for insulator change-out. A trunnion cap screw is merely backed off, and conductor (with clamp attached) lifted out of position. The same clamp will slip into position in a replaced insulator and be secured by tightening trunnion cap screw. *No loose parts* throughout insulator change.

THE LAPP CLAMP-TOP IS MOST DEPENDABLE

A principle of Lapp Post design is the *external* attachment of hardware—*bases and caps*. This assures that the porcelain body be loaded only in large-area low-intensity compression. This design takes full advantage of porcelain's superior compression strength, and provides an assembly greatly more secure than one subject to the high-intensity tension loading introduced by internal pins and inserts.



Lapp

For new ideas on economical, efficient line and station construction read the new Lapp Catalog Eight. For your copy, write Lapp Insulator Co., Inc., Le Roy, N. Y.

Contracts Placed for 2,000-Mw British Plant

Britain's Central Electricity Generating Board has placed record orders totalling some $95.2 million with International Combustion, Simon-Carves Ltd and English Electric Co, Ltd, for the new 2,000-Mw West Burton Power Plant.

International Combustion and Simon-Carves, who concluded a co-operation agreement last October, will supply four 500-Mw reheat coal-fired boiler units.

The boiler units, to cost some $53.2 million, will be of the controlled circulation type, skin-cased and arranged for cubic expansion down to the economizer outlet.

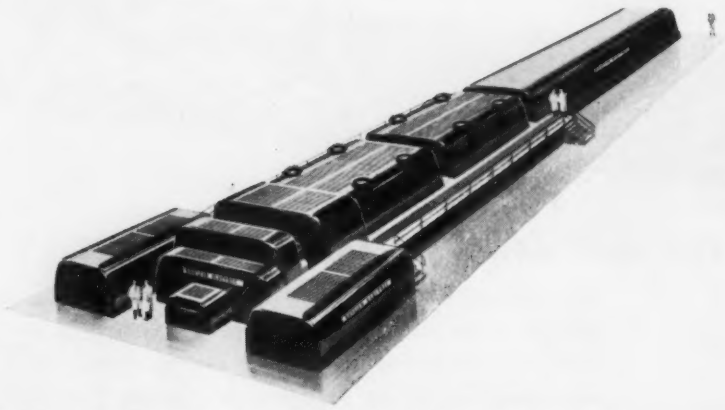
English Electric was given the $42-million order for four 500-Mw, single-line turbogenerators together with condensers and steam-turbine driven boiler feed pumps. The generators are to be the largest single-shaft sets in the world.

The first of the four units is scheduled to begin operation in June 1963—the whole station will be fully commissioned by the end of 1967.

Total cost of the station is estimated between $84 and $112 per kw of capacity.

The generating plant, together with condensers and steam-turbine driven boiler feed pumps, will be installed in the Board's new 2,000-Mw power station at West Burton, in the Trent Valley. The station, the biggest in Europe so far, will draw its fuel supplies from the nearby East Midlands coalfield, one of the country's principal sources of cheap industrial coal.

The 500-Mw unit represents a further development of the continuing range of large single-line machines introduced by English Electric Co with the commissioning in 1959 of the first 200-Mw set at the High Marnham Power Station of the Central Electricity Generating Board. In 1960, the company also received an order for one of the first two 375-Mw supercritical sets for the Central Electricity Generating Board. These sets will use steam at 3,500 psig and 1,100F, reheat to 1,050F. The 500-Mw units continue the downward trend in capital costs and generation costs.



ENGLISH ELECTRIC'S 350-Mw single shaft turbogenerator now under construction shows the general appearance of their 500-Mw units currently contracted

The 500-Mw unit comprises a multi-cylinder 3,000-rpm reheat turbine with multiple exhausts arranged as a tandem compound unit coupled to a hydrogen/water-cooled generator of the direct-cooled type.

The turbine operates with steam at 2,300 psig, 1,050F at the turbine stop valve with reheated steam to intermediate pressure cylinder at 1,050F.

The generator runs at 3,000 rpm, generates at 22 kv. It is designed for a short-circuit ratio of 0.4 and a power factor of 0.85 lagging.

The generator has three main components: a rotor machined from a single forging, an inner stator frame carrying the core and windings giving a transport weight of 196 tons, and the outer stator casing which is a welded steel cylinder designed to carry the inner stator and the hydrogen coolers.

Two fluids are used in the direct cooling circuits: hydrogen at 60 psig for the hollow rotor conductors and for the stator core, and water for the hollow stator conductors. The hydrogen is circulated by a multi-stage axial-flow blower mounted on the rotor shaft. The recooled gas enters the conductors at each end of the rotor body to cool the slot and end windings separately.

The stator core is cooled by a separate stream of gas; all the hot gas flows through the first stage cooler, and thence to the blower intake. The blower discharges through a diffuser to the second stage cooler, from which the fully cooled gas re-enters the machine.

The water for cooling the stator coils circulates in a closed circuit, make-up water being drawn from the station demineralized water supply when necessary.

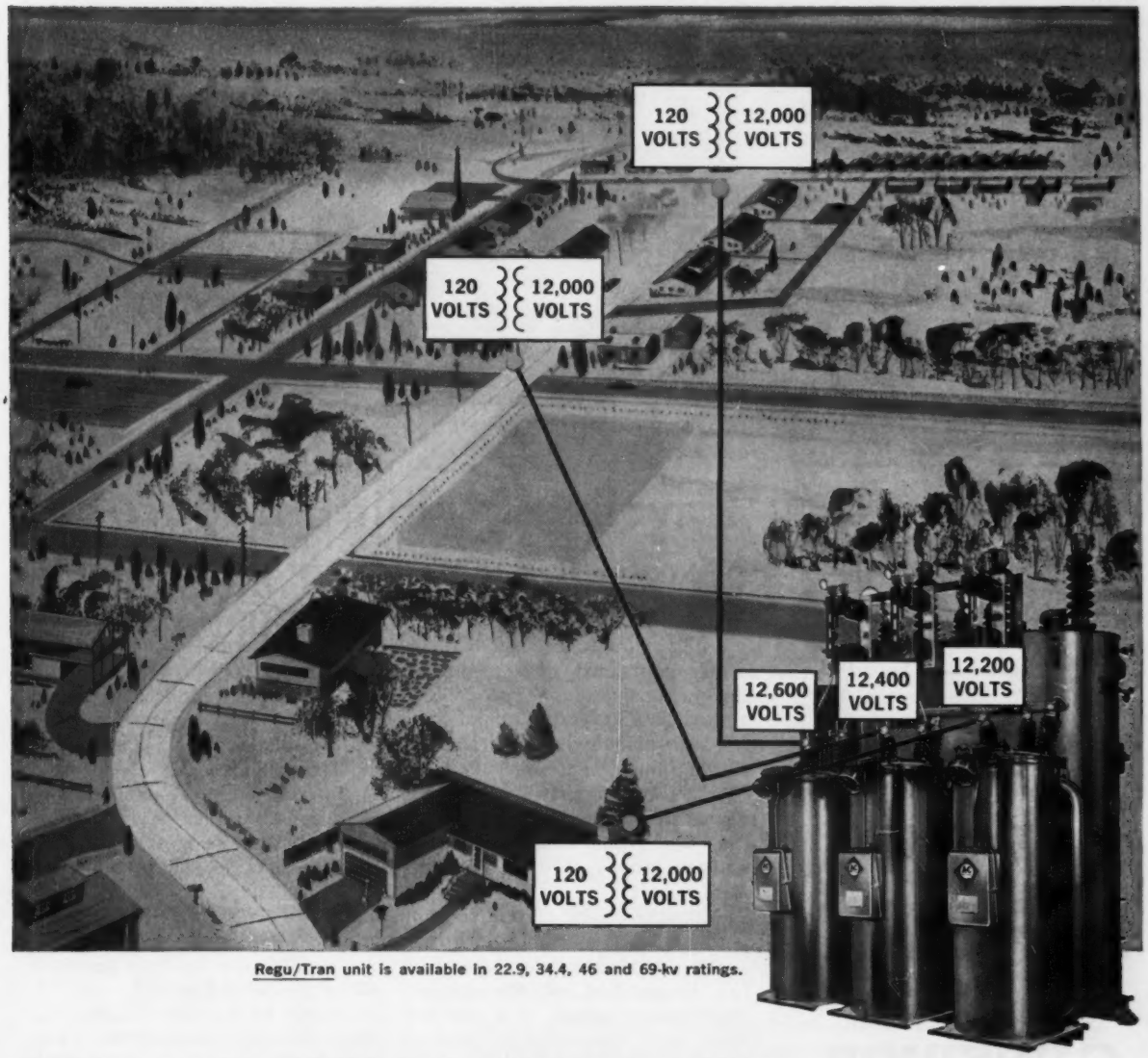
The hydrogen coolers and the heat exchanger in the stator winding water system are fed with condensate, so that a large part of the alternator losses is returned to the feed-water system.

Excitation current for the 500-Mw generator is provided by a direct-coupled exciter generator, the output of which is rectified by a bank of silicon rectifiers feeding directly into the slip rings of the main alternator rotor. Control of the excitation is obtained by means of a continuously acting automatic voltage regulator, which adjusts the rotor current of the exciter. This current is derived through rectifiers from a high-frequency alternator coupled to the exciter.

(*More News of Manufacturers, p* 78)

ALLIS-CHALMERS

A-1443



Regu/Tran unit is available in 22.9, 34.4, 46 and 69-kv ratings.

New Regu/Tran unit with independent phase regulation

improves voltage control, increases revenue

Regu/Tran units are the economical answer to the problem of unbalanced loads and varying lengths of single-phase feeders. Three single-phase regulators with famous *Feather-Touch* control are super-sensitive and responsive to voltage changes. You get 1% control accuracy and 20% range of regulation. Advantage: increased revenue, better customer relations through improved voltage regulation!

- **SAFETY** — By-pass switches when required are fully visible. Permit de-energizing regulators and control without dropping service.
- **TAILORED REGULATION** — If just ±5% regulation is needed, that's all you purchase. No need to pay for unused voltage range.
- **VERSATILITY** — Use transformer and regulators as separate units.
- **MINIMUM INVESTMENT** — Buy Regu/Tran transformer first. Add regulators, by-pass switches as you need them.

Check these additional benefits of a Regu/Tran *unit.* **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.*

Regu/Tran and Feather-Touch are Allis-Chalmers trademarks.

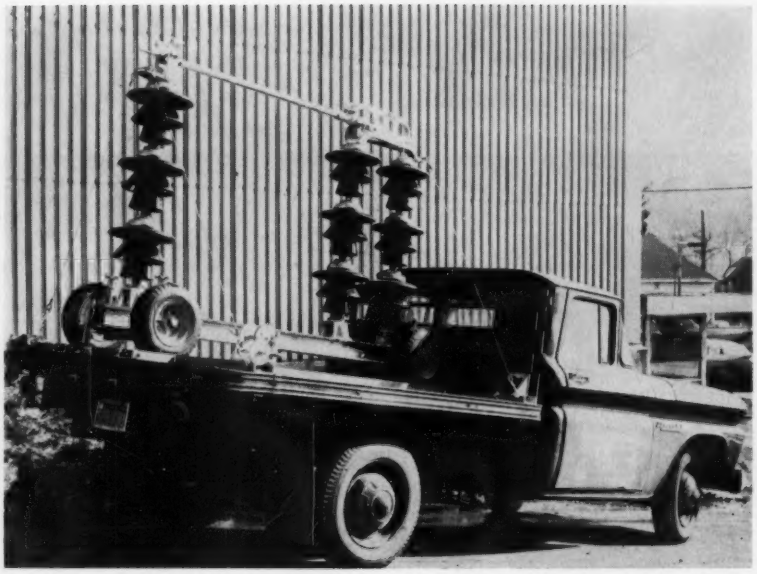
Searching for Test Facilities?

look to . . .

SUPERIOR SWITCHBOARD & DEVICES CO.
CANTON 1, OHIO
A Subsidiary of
The Union Metal Manufacturing Co.

Test Switch

Write for a free Catalog outlining types and sizes of test switches, test blocks, reactiformers, enclosures and meter socket equipment.



NEW I-T-E OUTDOOR AIR SWITCH starts on its country-wide utility tour

Traveling Exhibit Introduces New I-T-E Outdoor Air Switch

I-T-E Circuit Breaker Co recently completed final testing of their new outdoor, Type TTR-6, air switch. Currently, four of these full-size pole switches are being shown throughout the country. Mounted on special frames, they are easily removed from light carrier trucks for demonstration to selected groups of utility management people.

Aluminum-alloy current-carrying parts and base assembly have been jointly designed and developed with full cooperation of the primary aluminum suppliers. For the first time, new high-strength alumina porcelain insulators are used in 3-in.-bolt-circle stacks in ratings from 115 through 161 kv. These new I-T-E dark blue-glaze porcelain units, assembled in stacks for 450, 550, 650 and 750-kv BIL ratings, were developed and tested by the Victor Insulators Division.

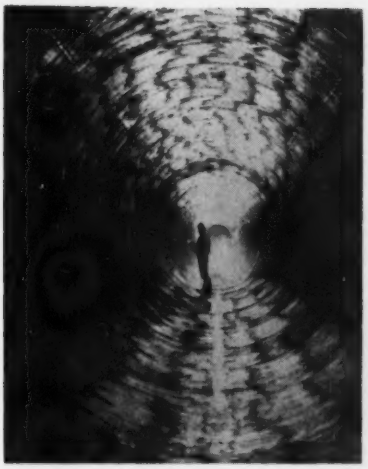
Silver-to-copper contacts have been retained as a major feature of jaw and hinge construction in the new current carrying parts. At the break-contact end and the sealed-pressure-hinge end of the blade, the transition from aluminum to copper is a special development of aluminum alloy specialists, working with I-T-E engineers. A unique combination of copper and aluminum parts is featured in the new jaw design, which provides for retention of full blade contact under high fault conditions.

Bases are welded aluminum-alloy extrusions, forming a rigid, box-girder type of support for the insulator stacks. The rotating insulator shaft does not protrude below the bottom base plane, thereby permitting the complete single pole to be set down anywhere when moved or handled.

Weight of the new switches has been reduced about 45%, which permits the use of manual, torsional operation instead of geared mechanisms usually needed.

Complete single-pole and three-pole switches have been subjected to all required performance tests. A three-pole, 600-amp, 550-kv BIL switch has withstood a 61,000-amp momentary test, 30% more than required. It passed the required thermal test shortly thereafter, showing no damage to any functional parts. The switch successfully met the 4-sec required tests.

The fully assembled switch is shipped fully adjusted and ready for installation.



INNER SURFACE of 328-ft section of penstock is inspected after 3½ years—will last 40 years, says Koppers Co

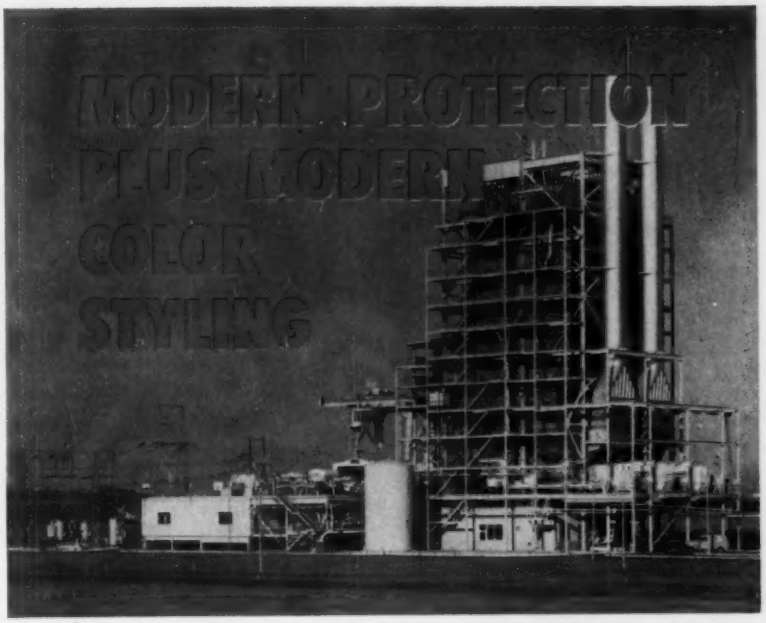
Aged Coating on Bersimis Penstock Still Like New

Coal tar coatings on the steel-plate surfaces in eight penstocks at the huge Bersimis River power project in northeastern Quebec are in as good condition now as the day they were applied 3½ years ago by Koppers Co, Inc, Pittsburgh, Pa.—according to the findings of the recent official general inspection of the project by the Quebec Hydro-Electric Commission.

Examinations by the Quebec Hydro-Electric Commission and Koppers Co engineers, upon opening of the penstocks during the inspection, showed mere pinpoint imperfections in a few scattered areas which required minor touch-up attention. This involved less than 1/12 of 1% of the total 77,000 sq ft of coated metal and resulted not from wear and tear on the enamel but from the high rate of moisture condensation during application.

The portions of the penstocks coated with coal tar enamel consisted of horizontal 328-ft-long sections below the elbow of each penstock. In the coating work, an application of fast drying primer was followed by a double hand-brushed coat of coal tar enamel.

The enamel, which is subject to a maximum pressure of 540 psi, will last well over 40 years, according to engineers of Koppers Co—manufacturer, supplier and contractor for the coating application.



SUBOX PAINTS

Corrosion protection has too long been associated with drab appearance. Now you can paint to have modern protection plus modern color styling.

Subox paints are now blended in a range of tones which make it possible to decorate property and make unsightly structures pleasing. Give your own good taste free rein.

Regardless of the colors you choose, you will be assured of the most tenacious kind of corrosion protection. Subox paints are the only American paints made with *suboxide of lead*. They remain chemically active, even after drying, to form an interlocking fibrous film that withstands the most punishing exposures.

Subox paints are very economical. One or two coats do the work of two or three of ordinary paints. And a Subox application lasts an average of 6 to 8 years.

Send for color card and literature.

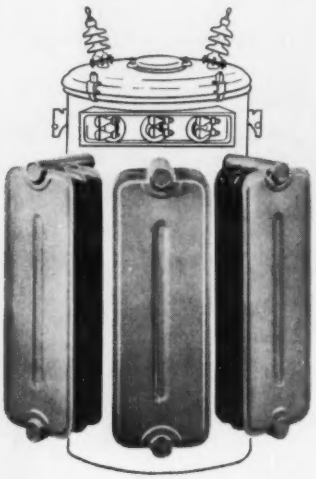
SUBOX PAINTS

Subox Inc.
Trade Mark

Established 1924
3 Fairmount Plant, Hackensack, N. J.
Subox Company of Canada, Weston, Ontario

New Equipment

Transformer Radiators . . .



. . . feature up to 40% lighter weight, compact design, low installation costs, application flexibility and high cooling efficiency. Flexoplate radiators for distribution transformer and small power transformer cooling have weight savings resulting from plate-type design and construction, employing an oil-film principle in relatively thin plates. Standard factory-fabricated units for distribution transformers are available in 9 and 12-in. widths, with eight standard lengths ranging from 25 to 60 in. Standard radiators for small power transformers are furnished in a 15-in. width and in 60, 72, and 84-in. lengths. Assembled radiators are made up of two to six plates for distribution transformers and up to ten plates for the smaller power transformers.

Flexoplate Div, Tranter Mfg, Inc, Lansing 9, Mich.

Lightning Arresters . . .

. . . have unitized spark gap, combined with an improved valve element perfectly mated to the interrupting ability of the gap structure. These Unigap distribution valve lightning arresters are available in 3, 6, 9, 10, 12, 15, and 18 kv. The new-type unitized gap construction combines the functions of both a spark gap and separate coil in a single, rigid, precision assembly. Rapid magnetic arc movement and power follow current interruption are accomplished without an auxiliary coil of any kind. Arresters incorporate low and consistent sparkover, approaching or exceeding present-day ASA station arrester requirements, plus follow current interrupting ability ten times that required for average service.

James R. Kearney Corp, 4236 Clayton Ave, St. Louis 10, Mo.

Compact Hv Testers . . .

. . . both ac and dc, conform to ASTM Specification D-149-59. The ac line consists of 15 ratings in two classifications: 2 kva at voltage ratings of 20, 35 and 50 kv and 5, 10 and 25 kva at voltage ratings of 50, 75, 100 and 150 kv. Dc test sets are available at 5 and 10 milliamp, at ratings ranging from 30 to 150 kv. New safety features on the ac and/or dc sets are interlock connection, zero-start interlock, safety contactor and indicating light, complete enclosure and grounding facilities. The sets can be used by utility central stations and laboratories to test dielectric materials and all kinds of insulated electrical equipment.

General Electric Co, Schenectady 5, N. Y.

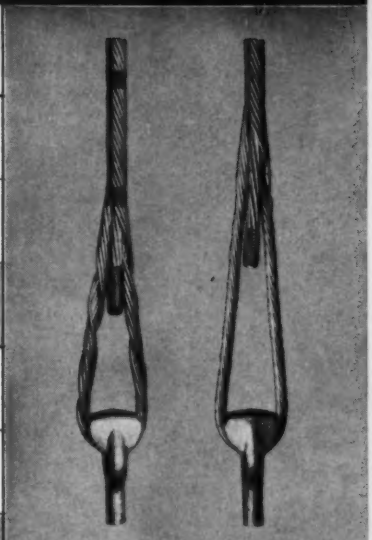
(More New Equipment on page 83)

Best buy for dead-ending a guy...

FANNER *Superformed** FANNGRIPS

COMPARE THE DIFFERENCES BEFORE YOU BUY HOLDING DEVICES

	Fanngrips	Automatic Jaw Types	Bolted Clamps and Clips	Manually Moused or Served
EXPERT INSTALLATIONS EASY with little skill, no tools or dies	YES	YES	NO	NO
NO-SLIP GRIP even for highest loads	YES	?	NO	NO
STREAMLINED FLEXIBILITY without excessive weight	YES	NO	NO	YES
DURABILITY at lowest cost	YES	NO	?	?
SIMPLICITY with highest strength, efficiency on EHS strands	YES	?	NO	NO
HIGH VIBRATION-FATIGUE RESISTANCE	YES	NO	NO	YES
RE-USABLE with lasting efficiency	YES	?	YES	NO



FANNGRIPS are available with open-loop design (left) for flexibility and resilience upon impact, or closed twisted-loop in many sizes for compactness where space is scarce.

Fanngrips . . . time-proved, top-quality research/development products of Fanner, world's FIRST MAKER of machine-formed armor rods . . . provide the best available means for guying pole structures.

In addition to the cost-saving advantages shown above, Fanngrips are the only non-slip dead-ending device without biting, strand-weakening jaws.

They provide maximum installation-safety, too. Wires are chamfered at ends, surfaces smooth. No burrs or jagged points to cut hands or snag gloves.

Available from stock for all sizes of galvanized steel, aluminum or copper-covered steel strands. They can also be supplied in other metals to match the strands they hold. Ask your Fanner representative for details, and for Bulletin FG-1 containing graphs for estimating savings in costs of guying materials.

A FEW FANNER *Superforms* and FINEST PLASTIC PRODUCTS

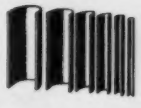
ARMOR RODS . . . Protect long spans at supports

LINEGUARDS . . . Protect short spans at supports

FANNGRIPS . . . For dead-ending strands or conductors

FANNSPLICES . . . For joining or patching strands

Plastic **TREEGUARDS** . . . Protect conductor surface covering



Plastic **KOVER-GUARDS** . . . Protect surface-mounted conductors

*A superior forming method in accordance with Patents No. 2,769,478 and 2,588,663—other patents applied for.

THE FANNER MANUFACTURING COMPANY
Brookside Park • Cleveland 9, Ohio

DIVISION OF TEXTRON, INC.

Fine Fanner Superformed Products

A-6025A

Can you see any difference?

O-B puts lightning immunity into small pintype insulators--a big added value at no extra price.

Is this just like any other pintype insulator you buy? Does it look the same? Chances are it does.

Take another look. See the scars on the porcelain? These are from repeated electrical discharges many times as severe and destructive as natural lightning. O-B has one of the very few laboratories in the world that can *produce* such a discharge - - and, to our knowledge, the only low voltage pintype that can *take it.*

The combination of unexcelled technical facilities, and a desire to apply these to the development of a low-cost insulator, are unique in the electrical field. The difference isn't in shape, or size, or even price - - the difference is in performance, and in saving the high expense of detection and replacement of lightning-damaged insulators.

Because they seldom have shielding, distribution lines have high exposure to lightning attack. This can't be cured by an insulator, but it can be combated. This is the big extra you get when your lines are insulated with O-B. They don't puncture. They truly do save you money because of this - - a lot of it!

O-B pintypes are as handy to you as your telephone. Graybar can deliver them to your door today if you need them that quickly.

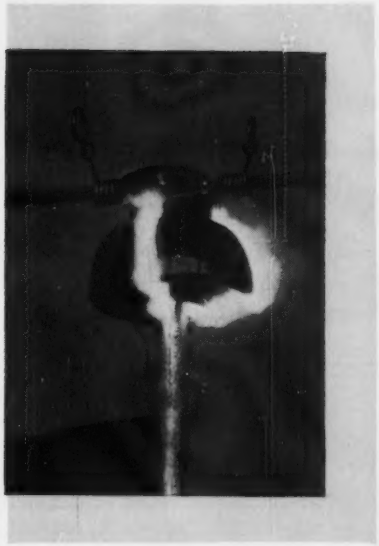
OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

HOLAN

10131-H

Distributed by Graybar Electric Company

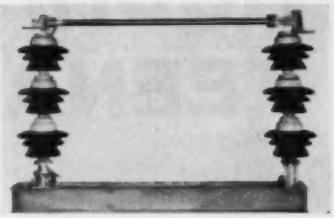


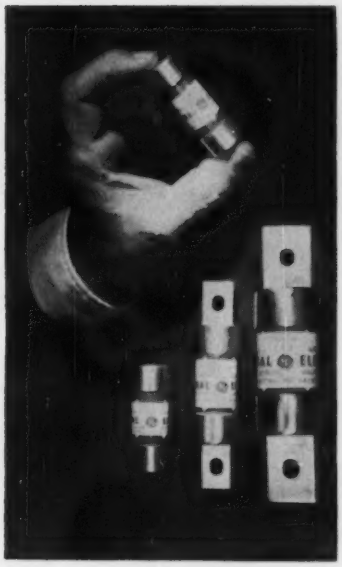
Far more wicked than natural lightning - - this O-B distribution pintype is withstanding an impulse discharge having the phenomenal wave front of 8,000,000 volts per microsecond. Destructiveness of this discharge is many times what can be encountered in service. It will shatter the average insulator but in the case of O-B, it can be applied repeatedly without harm. The insulator on the opposite page shows the result of this extremely severe test. The glaze has been burned by the great heat in the flash, even though its duration was only in the order of 8/100 of one millionth of a second. Otherwise the insulator is perfectly sound. Its full useful life has not been impaired.

When you buy distribution insulators remember what you have just seen. You are also buying the ability of the manufacturer to reproduce the basic design faithfully in large quantities over long periods of time. And you pay nothing extra for this protection to your service.

Side-Break Switch . . .

. . . incorporates braidless design and has recently been satisfactorily tested at short circuits of more than 70,000 amp at 115 kv. Type RSL side-break switches are available in 600 amp, 40,000-amp momentary rating and in 1,200 amp, 61,000-amp momentary ratings from 7.5 through 161 kv.
Royal Electric Mfg Co, Inc, 1122 E 87 St, Chicago 19, Ill.



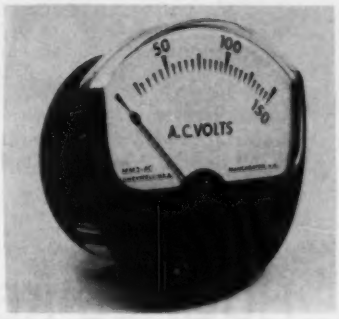


Class 'J' Fuses . . .

. . . are up to 50% smaller than previously. CLF fuses, from 3 to 600 amp, 600-v ac, with interrupting capacity of 200,000 amp rms, are used in plants with safety switches, interrupter switches, combination starters, QMR panel boards, LB-1 power protectors and motor control centers. They feature a notched wire pure silver element, which is said to give increased limiting ability. Since the fuses have a lower watts loss, switches and other fused devices run cooler at present ratings, permit closer fusing, and reduce derating factors.
General Electric Co, Schenectady 5, N. Y.

Ac Meters . . .

. . . for panel mounting include iron-vane ac voltmeters, ammeters, and milliammeters. This new line is matched, stylewise, to the Honeywell line of dc meters and is available in both the Medalist and in standard-case versions: voltmeters in 1 to 800 v; ammeters in 1 to 800 amp; and milliammeters in 10 to 800 milliamp. Moving iron-vane mechanisms are the basis for these units' reliability, and feature magnetic damping, impregnated field coils, and selected fixed and moving iron material.
Precision Meter Div, Minneapolis-Honeywell, Grenier Field, Manchester, N. H.

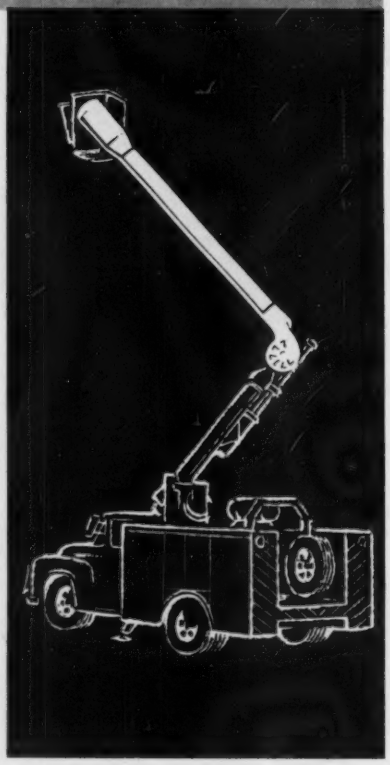


(*More New Equipment, p* 84)

HUGHES-KEENAN *introduces*

GLASS BOOM

for the famous **SKYWORKER**



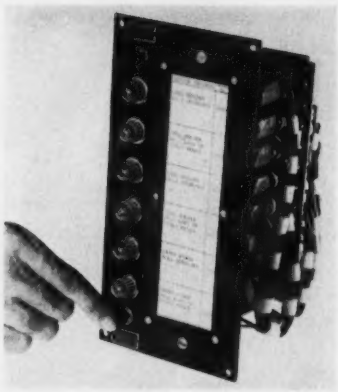
As the new manufacturer of SKYWORKER, HUGHES-KEENAN believes that in work aloft, where maximum safety is the important factor, there can be no compromise. On that principle SKYWORKER now offers a fibre glass boom of a specific design, together with stringent quality control of raw materials, compounding and molding, and with rigid inspection facilities *that assure you the safest glass boom you can buy*. Write or telephone today for full details.

HUGHES-KEENAN . . . *for 35 years the manufacturer of the versatile ROUSTABOUT material handling crane.*

HUGHES-KEENAN DIVISION

U.S. Air Conditioning Corp.

P.O. Box 360 • DELAWARE, OHIO • Telephone 363-1231



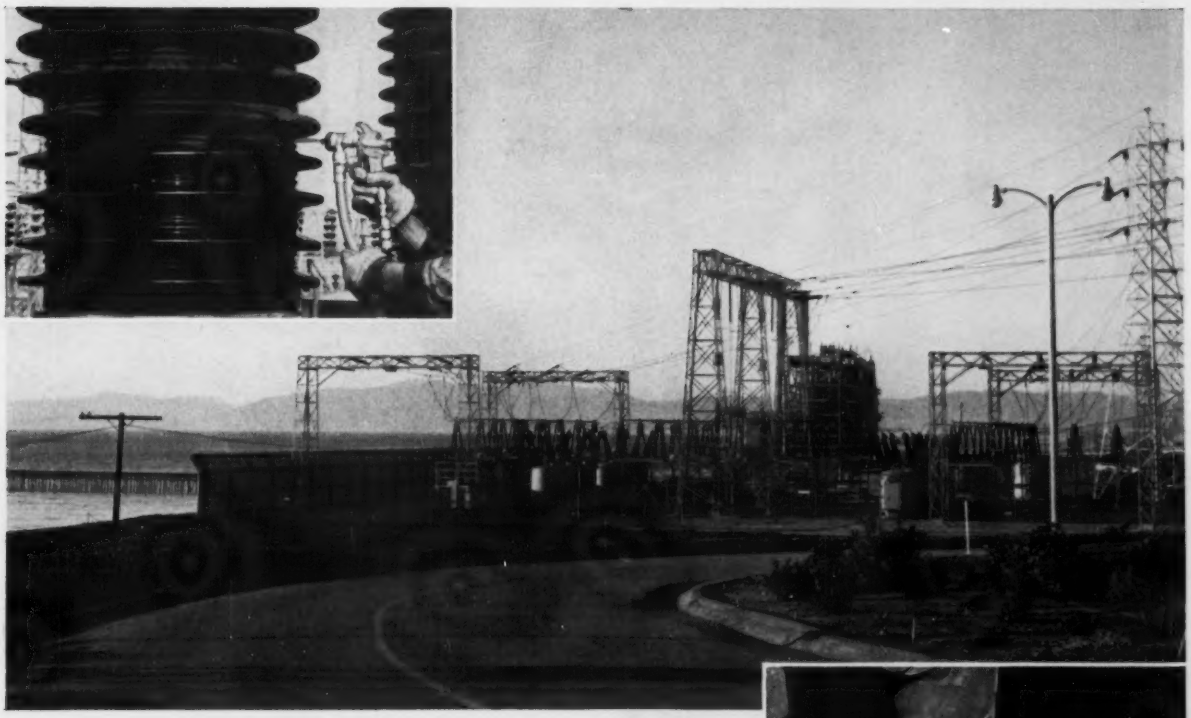
Static Fault Finder . . .

. . . features static magnetic-type switching and memory-type operation. The Bulletin 5205 static fault finder, for operation with 115 to 300-v dc or 120-v, 60-cycle control circuits, has low-voltage incandescent lamps which indicate fault. Each lamp remains lighted until manually reset, even though the fault has been cleared. The unit is ideally suited for detection of open contacts in protective or emergency stop circuits. The fault finder can monitor one to six individual devices by means of six full-wave, self-saturating magnetic amplifiers; if more than six circuits are required, additional amplifiers can be used. Input power is 115 v, 60 cycle, and the unit is designed to operate within a ± 15% line variation. **Clark Controller Co, 1146 E 152 St, Cleveland 10, Ohio.**

Multi-Speed Motors . . .

. . . in 2, 3, and 4 speeds are available in a variety of torque and horsepower characteristics. They are designed for driving machines requiring more than one constant speed. Savings are said to result from elimination of mechanical speed-changing devices and lower installation costs. The ac motors are available in from 1 to 100 hp; 3 or 2 phase; open, enclosed or explosion proof; speeds from 3,600 down to 450 rpm.
Howell Electric Motors Co, 16316 W Seven Mile Rd, Detroit 35, Mich.

No Flashover–No Leakage



Easy-To-Apply Silicone Coating Stops Arcing, Cuts Maintenance

With the wind-whipped Pacific Ocean less than 500 feet away, insulators in the switchyard of the El Segundo Steam Plant of Southern California Edison Company appear easy pickings for salt spray contamination . . . flashover . . . insulator leakage . . . lots of problems. But Southern California Edison has an effective and economical method for dealing with these contaminants.

An easily applied coating of Dow Corning 5 Compound causes mist, fog, spray and other moisture to "bead" and roll off without forming damaging conductive paths. The results: greatly reduced arcing and flashover damage to insulators; reduced service interruptions; reduced insulator maintenance costs.

Southern California Edison first applied Dow Corning 5 Compound on insulators in 1955. Insulators formerly washed down twice a month now require a silicone coating renewal only once a year. Outages and insulator damage have been eliminated while direct maintenance costs (labor and material) have been reduced.

Silicone compound can be applied with a rag or stiff brush . . . or recently developed spray equipment.

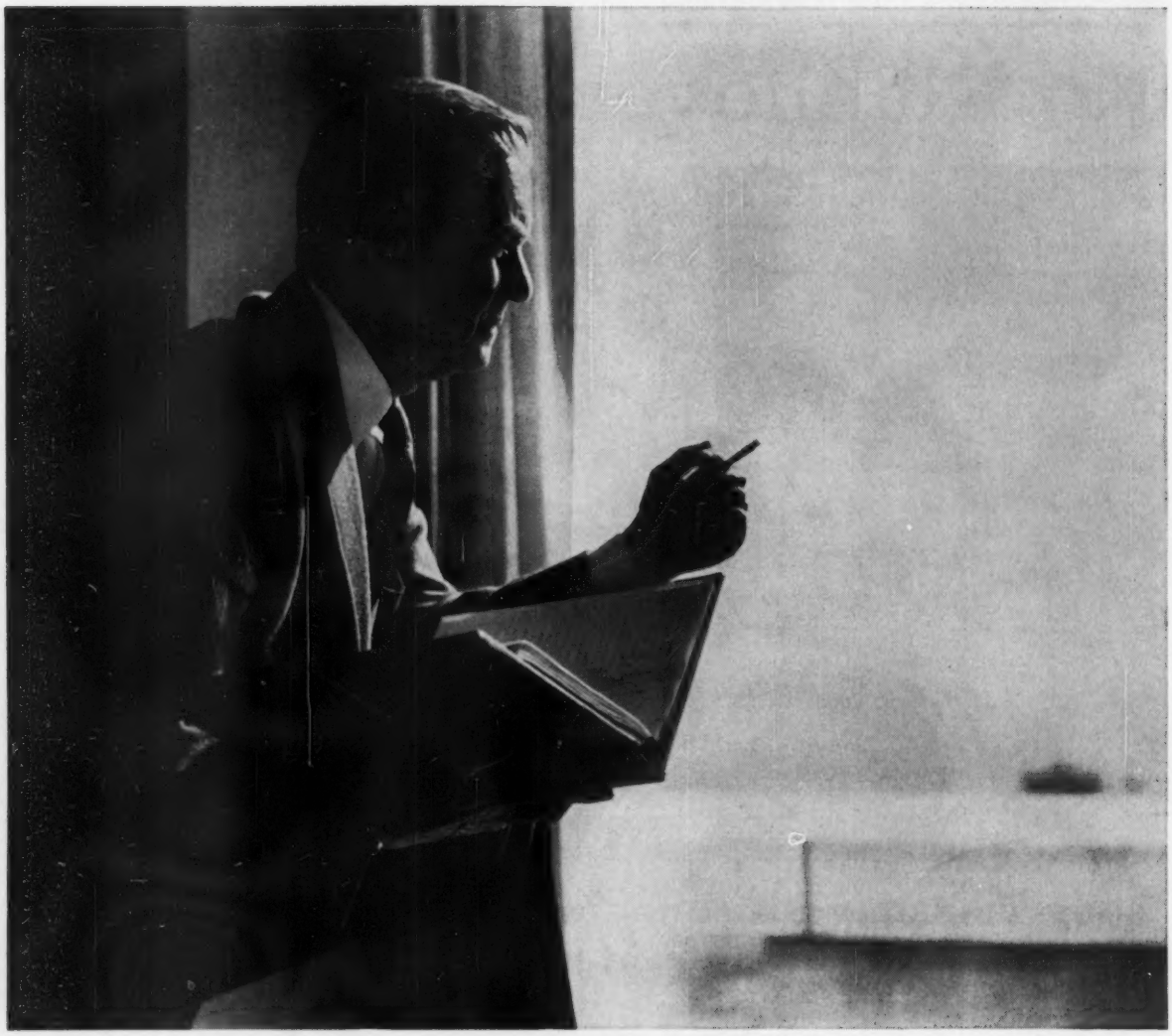
For free eight ounce evaluation sample, and information detailing how you can eliminate outages and insulator damage, write on your company letterhead to Dept. 3115.

The nearest Dow Corning office is your number one source for information and technical service on silicones.

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.



How long will utilities be able to buy the right kind of coal?

In the look-ahead world of electric utilities, 1981 can be here tomorrow morning.

The projected growth rate of electric needs makes it clear that the man who buys coal for a utility must pick his suppliers not only for what they can deliver now but for the next 20 or 30 years. He must be able to count on adequate reserves—of not just *coal*, but the right *kind* of coal. Coal that's free of hidden incremental costs that raise the invoice price with excessive coal handling, ash handling, equipment outages and freight charges on inerts. Coal that can deliver steam at the lowest possible cost.

To this utility man who lives partly in 1981, Island Creek offers a mighty reassuring picture of long-term quality and uniformity of supply. We'd welcome a discussion of your own searching look into that *very* near future. Write, wire or phone.

ISLAND CREEK Precisioneered Coal

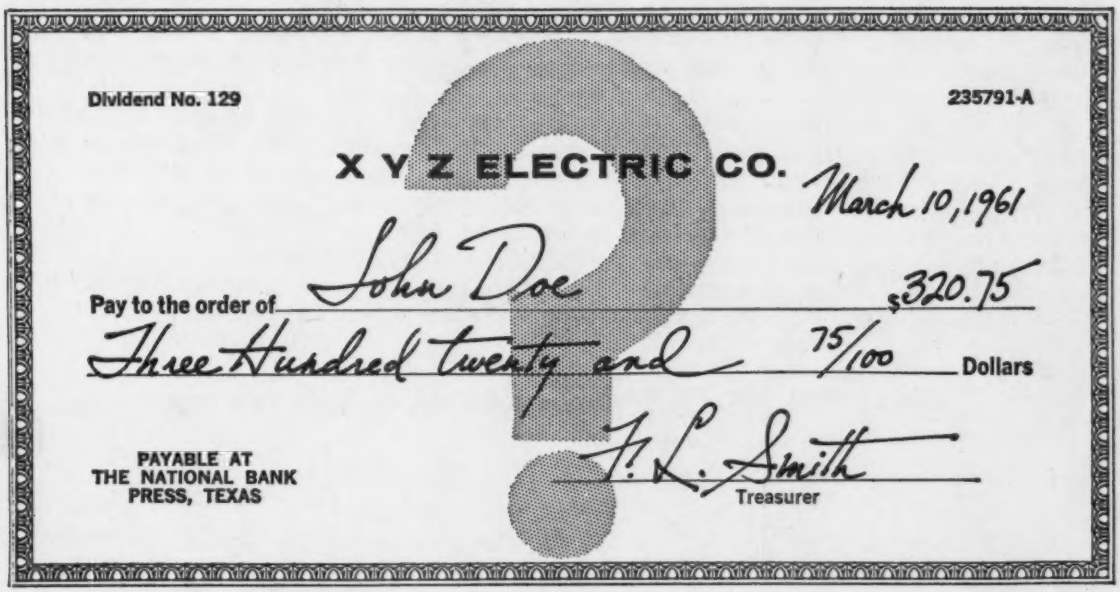
You can depend on Island Creek . . . a career company dedicated to coal

ISLAND CREEK COAL SALES COMPANY, Chafin Building, Huntington 18, West Virginia • Chicago • Cincinnati • Cleveland • Detroit • Greensboro • New York • Pittsburgh

Electrical World

MARCH 20, 1961

Management Newsletter



How Much for Dividends?

How much of its earnings should an electric utility pay out as dividends? How important are dividends in maintaining a high price-earnings ratio? The traditional answers to these questions hold that utilities should pass most of their earnings on to the shareholders, and that high dividends are extremely important in boosting the price-earnings ratio. But today, many utilities are bucking the tradition. The standard answer no longer seems to be valid across the board.

To learn how high utility dividends should be, it's important to make an accurate evaluation of what utility stockholders expect from their investment. Do they want income, or do they want growth? What is their prime concern when they turn their nest eggs over to an electric utility?

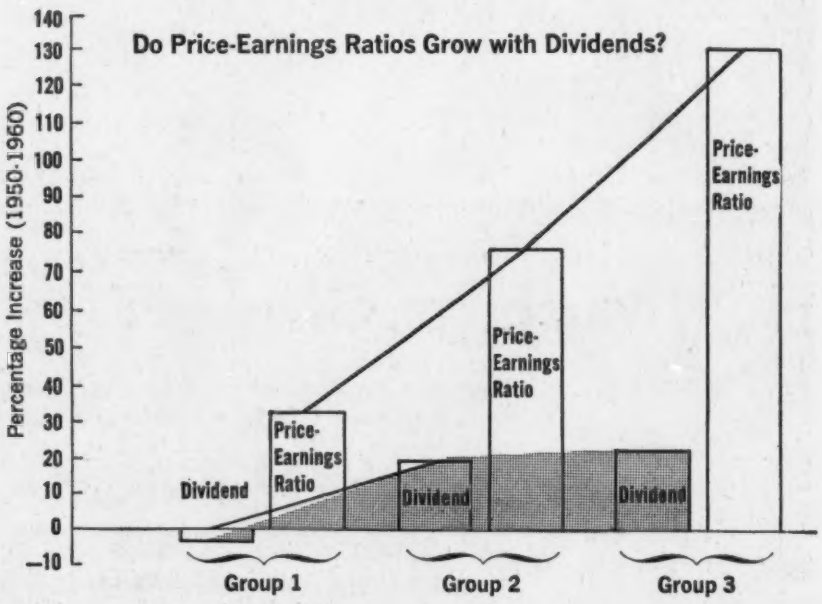
It has long been thought that the utility stocks appealed only to people who wanted a regular income. They were considered the perfect investment for the aging businessman. Money put into utility commons was as safe as money in the bank, and after retirement there was the steady flow of income not much smaller in amount than the company's earnings-per-share. The stocks also appealed to men setting up trusts for their families. The principal could be left safely intact, and it would produce a substantial flow of income for meeting ordinary, day-to-day living expenses.

There was good reason for investors who wanted income to single out the utilities. Electric companies sold a universally used product that seemed to guarantee steady earnings. Stable income, the financial texts tell us, means that a larger

percentage of the capitalization can be composed of bonds with fixed charges, but with lower interest rates. This feature makes possible large returns to the owners.

This desire for income from investments in utility shares is by no means dead. In fact, a case can be made to show that it's still the prevalent desire of utility investors. To illustrate this point, we can take those utilities which have shown an increase in price-earnings ratio over the past ten years and divide them into three groups. The first group are those with increases of over 100% in price-earnings ratio. Group two companies show an increase of over 67%, and utilities in group three have increased this ratio by less than 67%. After assuming that price-earnings ratio is an indicator of market demand, we can ask, "What policy did the companies in each group follow when it came time to mail out dividends?"

The 11 electric utilities comprising the first group paid out about 22% more of their earnings in 1960 than they did ten years before. The companies in the second group, which upped price-earnings by more than 67% raised their dividends by 19%. Group three companies with price-earnings increases of less than 67% did not, on the average, increase their dividends. In fact, for the group as a whole, the dividend payout was 3% less of earnings than it had been at the beginning of the decade. These data seem to indicate that during the Fifties the demand for utility shares went up with the dividends.



It is often argued from a broad look at the industry that the level of dividends is the key to maintaining a high price-earnings ratio. Naturally, this ratio is important to a utility, since it influences the cost of debt capital, and is indicative of the rate at which new common stock can be sold.

But no utility or state commission can make a decision based on such a general view of utility performance. They have to get closer to the picture where all the details come into focus. And when you move in a little closer, the number of mavericks bucking the traditional trend is startling. Some of the industry's best performers are not up at the top in dividend generosity. To the contrary, many of them are paying out a good deal less of their earnings than companies coming nowhere near as close to running off the top of the board.

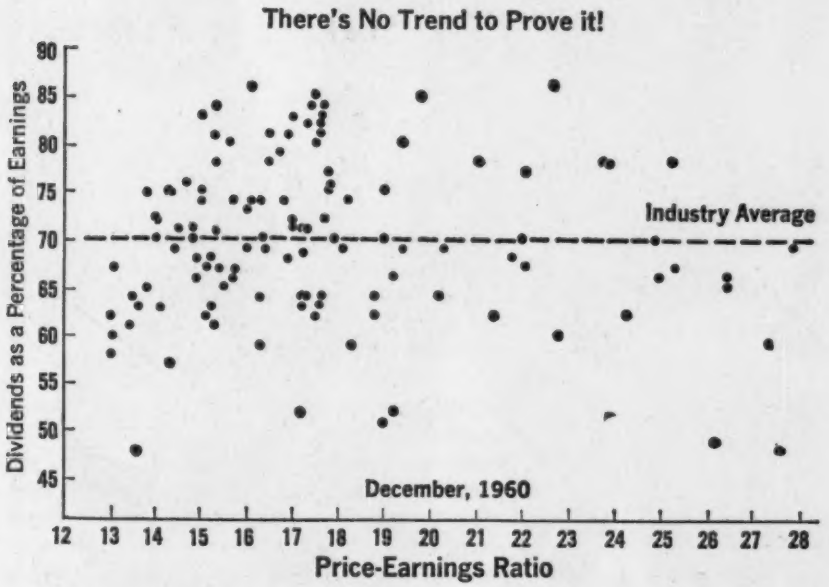
A quick look at some of the utility stocks which boomed during the Fifties demonstrates this point. Florida Power & Light; Tucson Gas, Electric Light & Power;

Texas Utilities; and Arizona Public Service, just to mention a few, have had tremendous increases in price-earnings ratio. But they have paid out less of earnings in dividends then the industry has on the average.

How do security analysts explain this situation? Many years ago, they say, you could establish a fairly clear correlation between the level of dividends for a utility and the level of its price-earnings ratio. The higher the dividend, the more appealing the share. But during the Fifties, the clear correlation faded.

The general rule that people buy utility shares for income no longer exists. Certainly, there are many companies that still pay the big dividend. But there are enough companies that are plowing earnings back into the business to make it foolish to attempt a general rule.

In the 1961 market, there is no convincing indication that yield is the primary concern of the utility shareholder. In fact, the average utility yield is quite close to the average yield for industrials. Industrials, during 1960, paid a yield of 3.48% according to Moody's industrial average. Utilities on the other hand mailed a 3.84%, return back to the shareholders. There were even times during the Fifties when utility yield was well below the industrial figure. In the ten-year average (1950-1960) utility yield is less than 0.2% above industrial.



On the other hand, there is evidence to support the analysts' contention that utility commons are no longer sought solely for income. The chart above plots each utility by two coordinates. The vertical axis indicates the percentage of earnings paid out as dividends. The horizontal axis shows the price-earnings ratio. Each dot represents a utility traded on one of the major exchanges, or over the counter.

If investors bought utilities purely for income, then there should be a correlation between price-earnings ratio and dividend payout. In this case, the pattern of points on the chart would indicate a trend. And that trend would move upward as it moves to the right. But it's impossible to draw in a trend line. After glancing at the chart, we can say that the majority of companies cluster around the 70% mark in percentage of earnings paid out, and around the 16-1 mark in price-earnings ratio. But as we move to the right (to companies with higher price-earnings), there is no perceptible trend toward higher dividend payout.

We can also plot the utilities against a slightly different pair of coordinates. Percentage of earning paid out as dividends will again be the verticle axis, but the horizontal axis will show *increase* in price earnings ratio between 1950 and 1960. Here again it's hard to find a pattern. But it would seem that the companies showing the biggest increases in price-earnings generally paid a lower percentage of income in dividends than did the industry in general. Some are paying less than 70% of the utility average.

Is there any relationship between dividend payout and price-earnings ratio? Certainly there is. But the relationship exists only for the individual company. A specific utility may well be able to affect the market price of its stock and its price-earnings ratio by a change in dividend policy. But there's no guarantee that raising the dividend will boost price. When you look at all the utilities you find that some companies have increased price with high dividend payout while others have increased it with low dividend payout. High dividends don't seem to be the critical factor.

Actually, we shouldn't be too suprised to find that dividends don't determine the price-earnings ratio. There are limitless factors that enter into the value that the market places on a company's stock. One standard reference text in business organization and finance lists these eight:

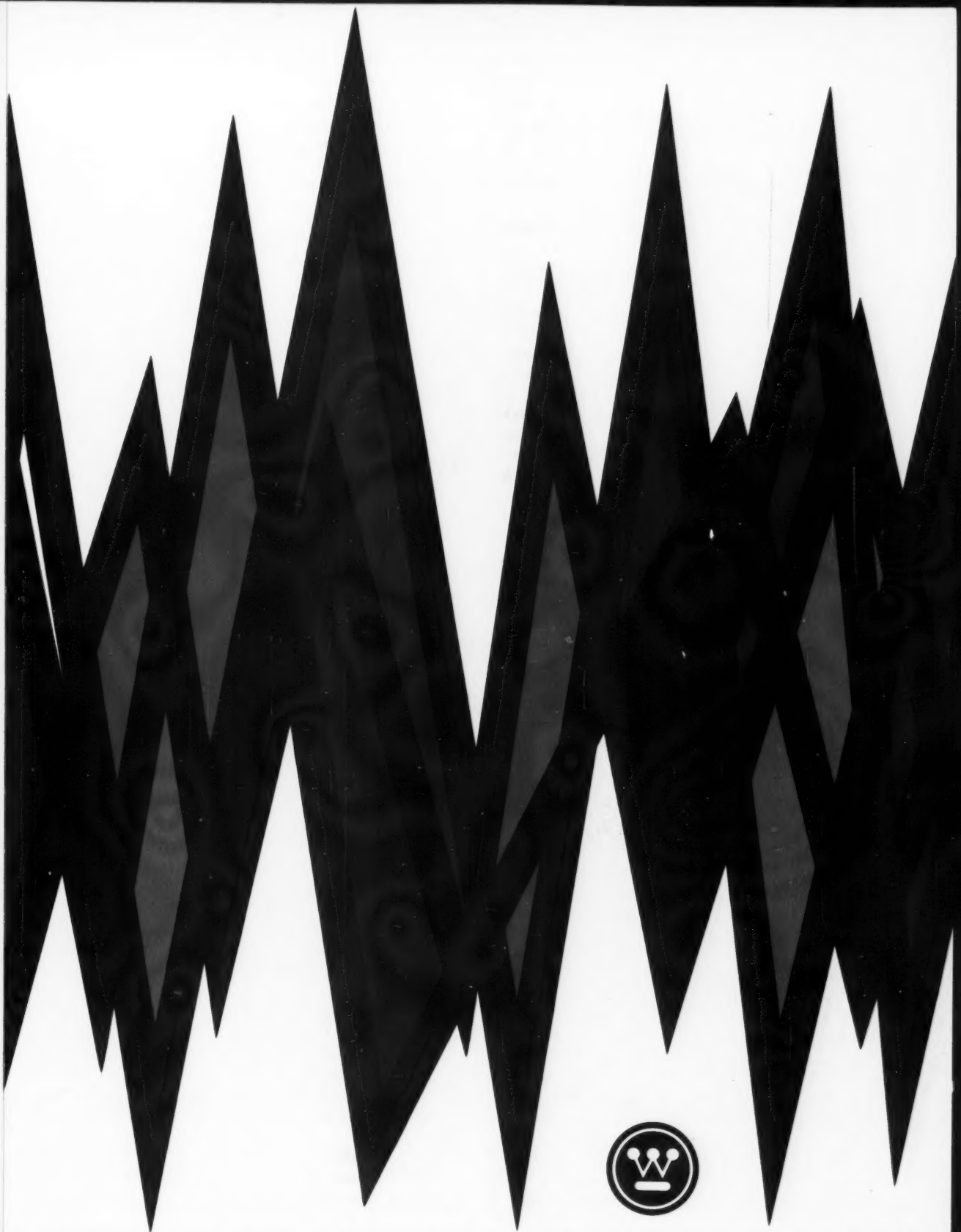
- Earning power
- Dividend policy
- Financial condition
- Management
- Expansion prospects
- Industrial outlook
- Condition of the money market
- Psychological factors

The potential investor looks into every one of these categories before he orders his broker to buy. Certainly he evaluates the company's dividend policy, and if he's looking for income this might well be his prime consideration. But if any of the other factors are more important to him, then dividend payout may not influence his choice.

Security analysts say that today's utility stocks cover every shade of the market spectrum just as industrial shares do. Some of the companies are growing at a steady rate and are quite capable of attracting all the funds needed through debt financing. These companies pay out most of their earnings in dividends, and are still a perfect choice for the investor who wants income. But there are many young utilities that are growing up in a hurry. These companies are turning most of their earnings back into the company in an effort to keep pace with exploding areas of the nation.

The stocks of these growth utilities appeal to a class of investors whose choice was formerly restricted to industrials. These investors have sufficient income to meet normal living expenses. Their big concern is with the future; with guarding their savings against inflation and with providing sufficient funds to meet college bills for their children. They want capital gains, taxable at capital gains rates, and not quarterly dividend checks from the utility.

How much should a utility pay out to shareholders? There's a right answer. But the answer is different for each company and finding it, as one text points out, requires the most astute financial management. No two electric companies are in exactly the same situation. And this means that no two companies should follow exactly the same dividend policy. To pick any rate and attempt to apply it as an optimum for all companies in the industry would be misleading and dangerous.



Effective power plant automation requires: a computer designed specifically for steam power plant process control; complete understanding of power plant equipment and processes for proper computer application • **Westinghouse provides this combination.**

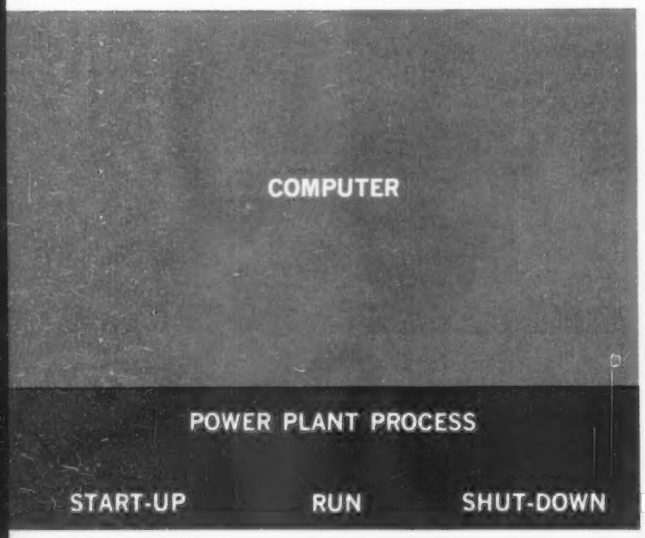
Westinghouse understanding of power plant operations is basis for PRODAC-IV design and application

There are two equally important parts to automating a plant. One is a good understanding of the process to be controlled. The second is the effective application of a large, reliable, solid-state digital computer specifically designed to supervise sequencing and control operations of the power plant process.

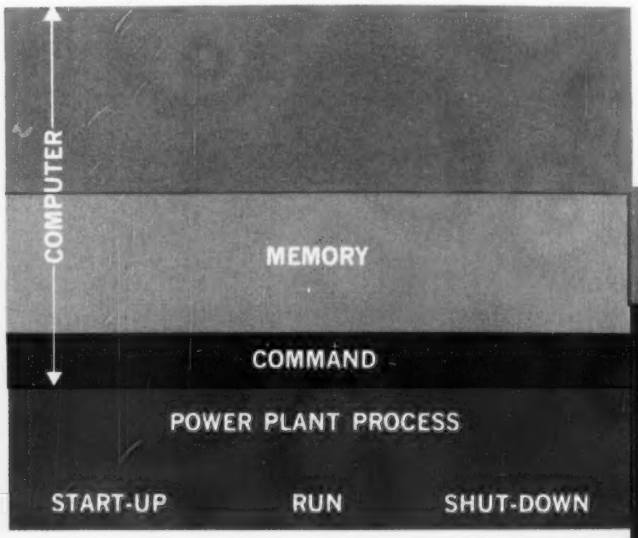
Westinghouse alone, with the PRODAC*-IV Computer system, is able to fulfill both parts of the problem. The series of illustrations numbered 1 through 4 shows how the Westinghouse PRODAC-IV system is matched to the total steam power plant process.

The remaining illustrations show how signals are

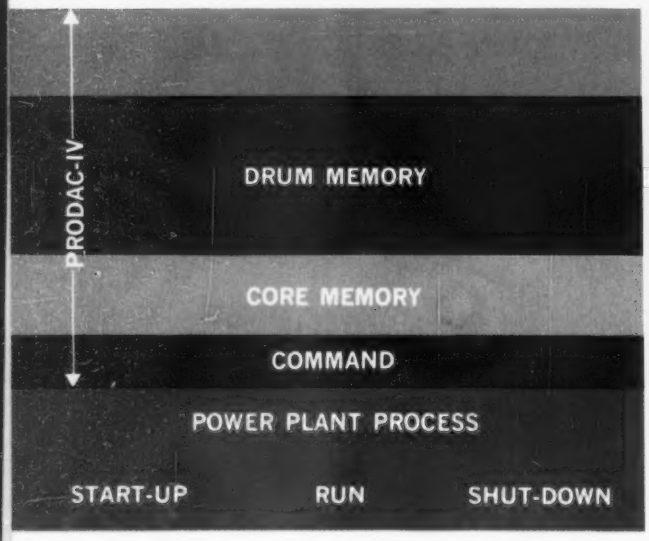
*Trademark



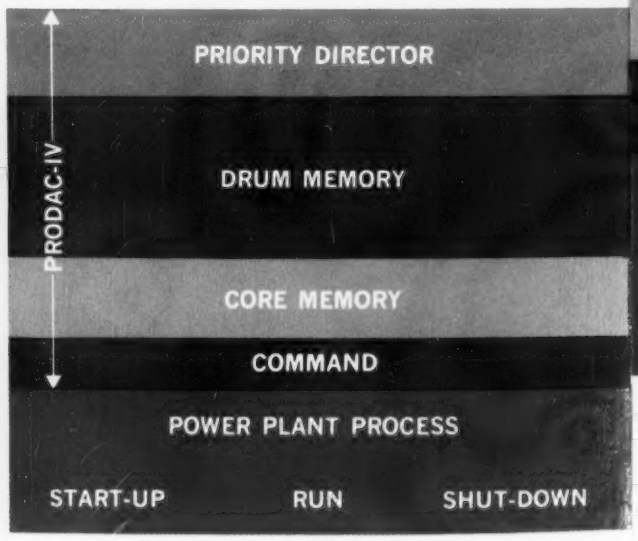
1 ANY COMPUTER, to provide full control of a steam power plant, must be matched to the total process from startup to shutdown. Full knowledge of plant dynamics is essential to make sure computer is able to handle all functions.



2 BOTH MEMORY AND COMMAND functions must be provided in the computer. The memory contains the thousands of instructions needed to control the process. The command system executes these instructions.



3 PRODAC-IV incorporates a drum and core combination memory. The drum provides economical bulk storage while the core permits rapid access. This system is more than equal to the task of controlling equipment directly during critical start-up and shutdown periods.



4 FULL CONTROL of an automatic steam plant requires simultaneous consideration of many sequences. To meet this demand, PRODAC-IV contains a priority director. This system, spread throughout the computer, selects programs to do the most important things first under all conditions.

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PRODAC-
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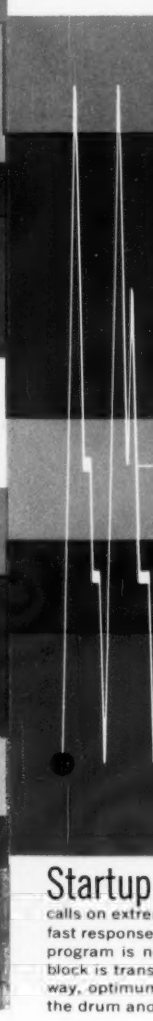

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from plant equipment and acted on by
-IV. At all times during the process, from
shutdown, sensors monitor all participating
t. During normal operation, if signals are satis-
RODAC-IV supervises plant process with con-
ained by sub loop systems. If the signal is off
owever, the priority director selects the proper
of action from the combination memory—
this program immediately by returning signals
ocess equipment. The PRODAC-IV priority
lso provides for storing the register contents
pended program and bringing in the contents
her priority program. This feature saves both
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ation memory and priority director—these are
f the design features which make PRODAC-
act match for the entire problem of power
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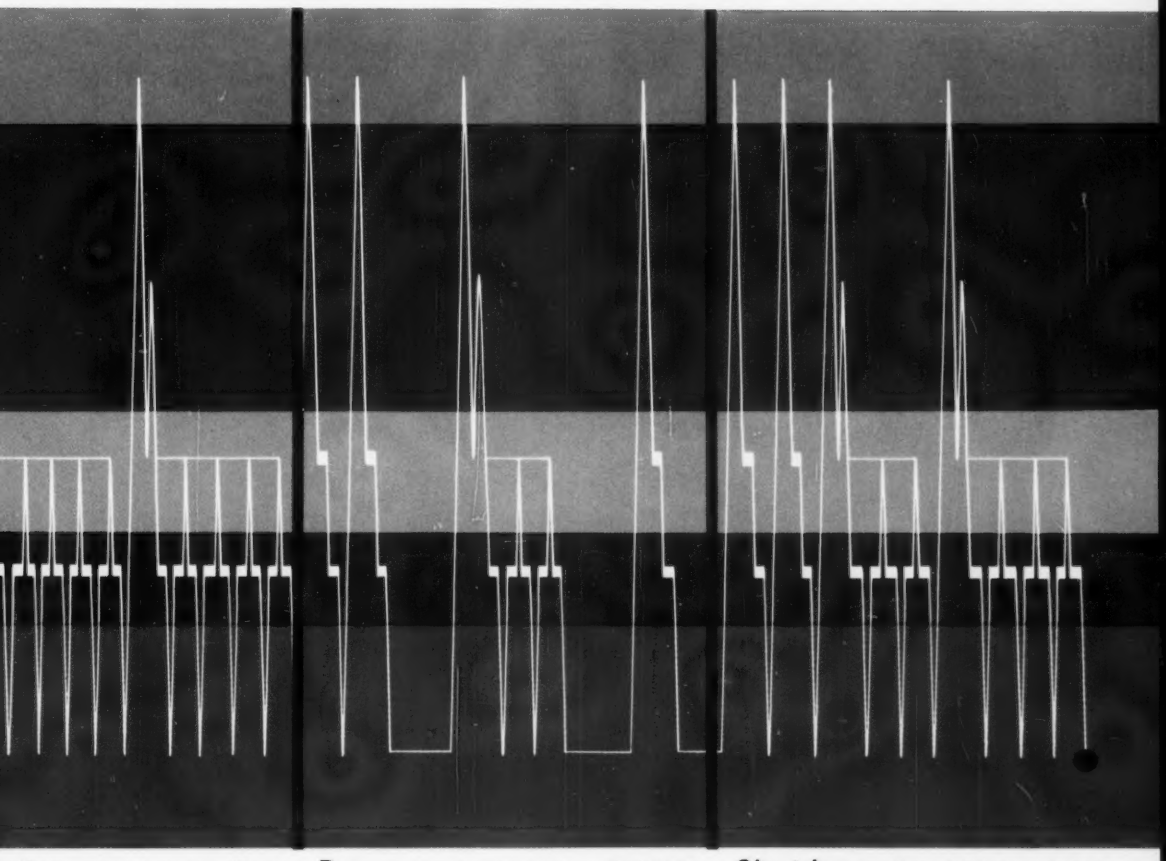


Startup operations are critical. PRODAC-IV's priority director emely high speed core memory for e to changing conditions. If needed not in the core, the required data sferred from drum to core. In this m use is made of bulk capacity of d rapid access of the core.

Run During normal operations, PRODAC-IV continuously monitors and checks plant performance. If no adjustments are needed, control is left at sub loop levels under supervision of computer. Periodically, set point adjustments are made to assure optimum operation. Should an emergency occur, priority director transfers to a corrective program.

Shutdown Upon initiation of shutdown, the proper programs are automatically transferred from drum to core. This combination memory system working in conjunction with the priority director makes PRODAC-IV more than equal to the problem of direct control of all participating equipment during this critical period.

Westinghouse

Westinghouse understanding provides added benefits in design of computer-controlled equipment

Experienced Westinghouse people, backed by vast analytical facilities, are the key to complete compatibility of PRODAC-IV and automatic power plant control. Programming specialists serve as part of the same team to make sure that every detail of your performance specifications is met.

You can put this team to work now to help in preliminary planning, or to prepare a concrete proposal for any automated power plant facility under consideration. As an added benefit, system analyses made in the course of preparing plans and proposals will establish many of the required characteristics of the power plant equipment, itself. Further, it may be determined that rearrangement of the plant cycle will facilitate automation of the plant.

For fast action contact your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

You can be sure . . . if it's

Westinghouse

File No. EU
CP-1062

Litho in U.S.A.

Selling

Electrical Research House Built

A bright red farmhouse high atop a hill at Dix Dam, Herrington Lake, Ky., may be setting the pattern for the future home life of many rural Kentuckians.

The house, built by the University of Kentucky College of Agriculture and Kentucky Utilities Co, is being used for research on the use of electricity for a variety of household jobs, particularly heating.

It is the end result of a design and construction study to come up with a small, practical all-electric home which can be readily duplicated in any section of the state, using materials easily available and using labor which is locally available in rural areas.

The university and the electric company shared the cost, with KU footing the bill for materials, and the college supplying the labor. Careful material lists, cost figures and time records were kept.

Cost records show $11,973 spent for materials and $4,776 for labor. These figures include items frequently omitted from building estimates such as the appliances, lighted patio, and attic ventilating fan.

The 1,080-sq-ft house meets the Gold Medallion Home standards.

In addition to the residence there is a combination shop, office, storage area and wash-up building which is 154 sq ft.

A cabinet hung on the rear of the house holds the key to the research possibilities. In it are 14 electric meters which measure just about every individual electric usage in the house.

The house is designed for other research, too, such as a comparison of the efficiency and performance of various types of electric heating, since in different locations ceiling cable, baseboard units, wall heaters and ceiling panels, all separately metered, have been installed.

Tests can also be made to determine whether there is a worthwhile saving in turning down bedroom thermostats at night or reducing temperatures in vacant rooms in electrically heated homes.

Lighting of Critical Parts Of Highway Justified

Lighting of critical sections of highways is fully justified by the night accidents it prevents, according to new findings of the Committee on Highway Illumination of the American Road Builders Assn.

Studies in Connecticut have established that lighting reduces night accidents 85% on highways and 60% in urban areas; studies by the Highway Research Board of accidents in Utah for 1953 and in Massachusetts for 1955 fixed costs at $5,213 for a fatal injury accident, $1,277 for a non-fatal one and $299 for a property damage accident.

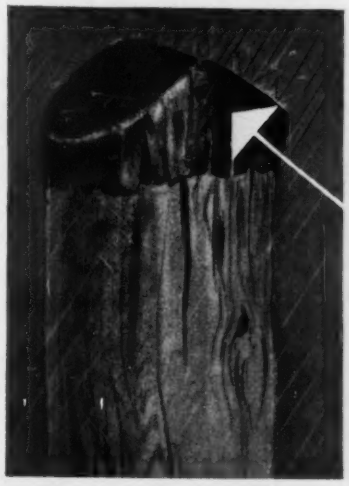
"Figuring that costs have risen 10% since these studies, we can now establish these accident costs as $5,734, $1,394, and $329 respectively," said Herbert A. Friede, committee chairman.

Farm Electric Sales Handbook Available

Newly revised and expanded edition of Farm Electric Sales Handbook has been published by Farm Group of Edison Electric Institute.

Booklet is intended as a reference by farm electric salesmen of utilities and manufacturers, giving information to enable the salesman to discuss an electric application with a farm customer and give the farmer an idea of what is involved in a particular job. For prices, write Sales Division, EEI, 750 Third Ave, New York 17, N. Y.

STOP ROOF DECAY THIS LOW COST WAY



USE IMPROVED OSMOSE POLE TOPPERS

Fungus decay, plus shrinking-swelling, freezing-thawing of moisture, can wreak havoc with your pole tops. And the damage can quickly extend right down to the crossarm area to cause expensive replacement of the whole pole. Why invite trouble? Take positive action now for long-lasting pole top protection.

The OSMOSE Pole Topper is a thick, reinforced cap. Applied with special 10% penta Pole Topper Fluid, it provides many years of extra "top life." Comes as a simple do-it-yourself unit. Lightweight, easy to carry and clean to handle. Can be applied in only one minute. Fits snug and will not crack or peel. For use on new and salvage poles in the yard, as well as standing poles.

OSMOSE Pole Toppers can be applied under contract or by your own linemen. Keep a supply on every line truck as standard equipment. For complete details, including special Pole Topper Fluid, write: Osmose Wood Preserving Co. of America, Inc., 976 Ellicott St., Buffalo 9, N.Y.

OSMOSE

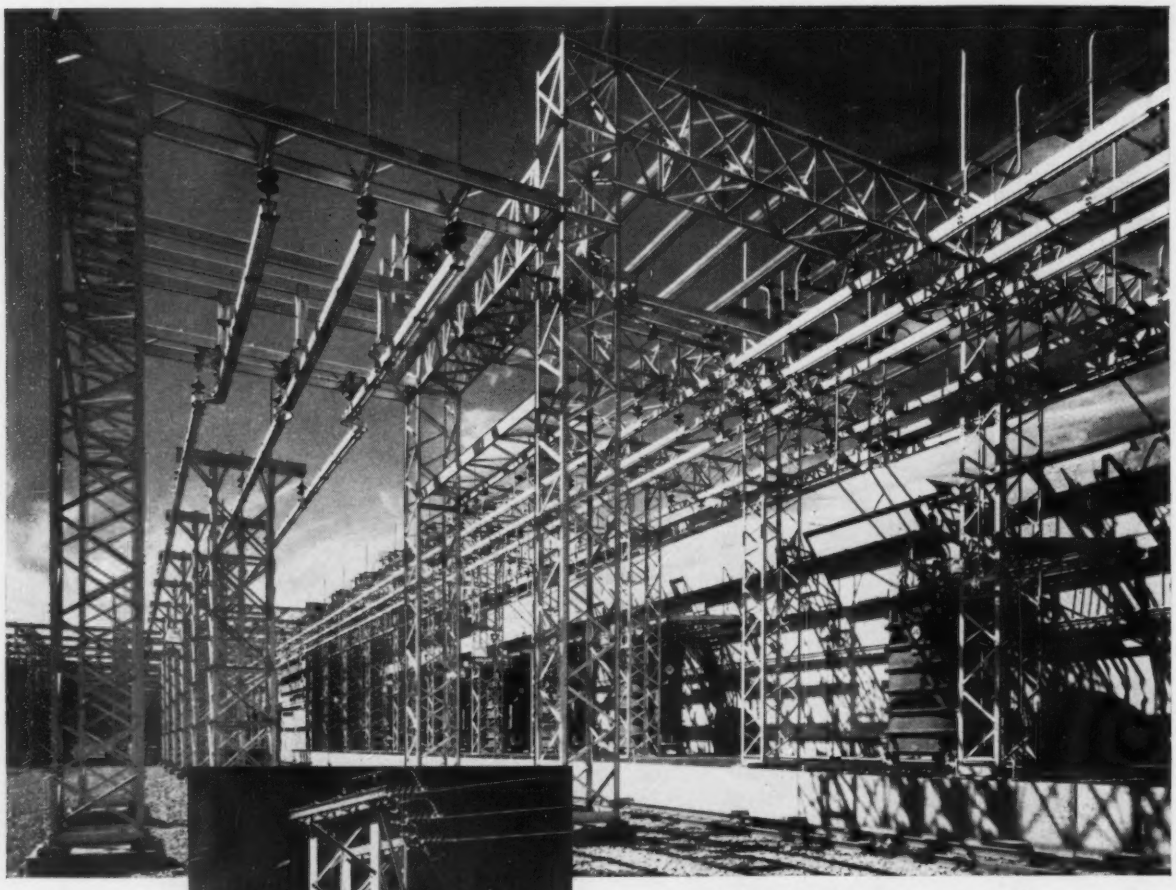
SERVING UTILITIES SINCE 1935

REYNOLDS ALUMINUM

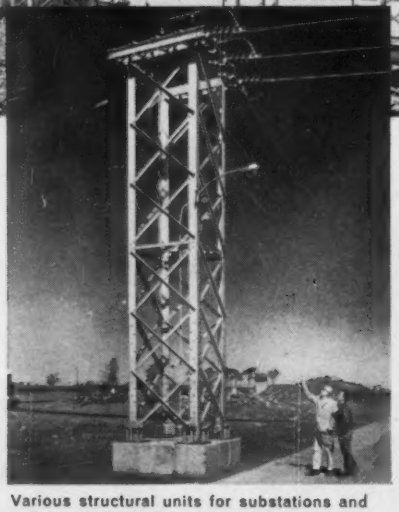
"custom tailors"

SUBSTATIONS and TOWERS

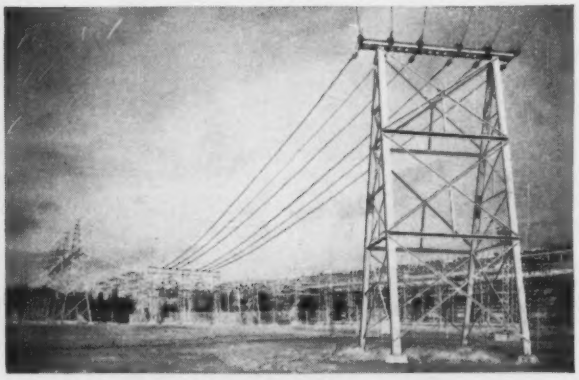
to cut weight, work, maintenance – and costs!



Light, bright aluminum substations not only look good, but *stay new looking* without expensive maintenance painting, even in most corrosive industrial atmospheres or coastal areas.



Various structural units for substations and switchyards can be built with standard aluminum structurals or structurals designed to meet specific requirements. In either case, aluminum structures lower handling and erection costs.



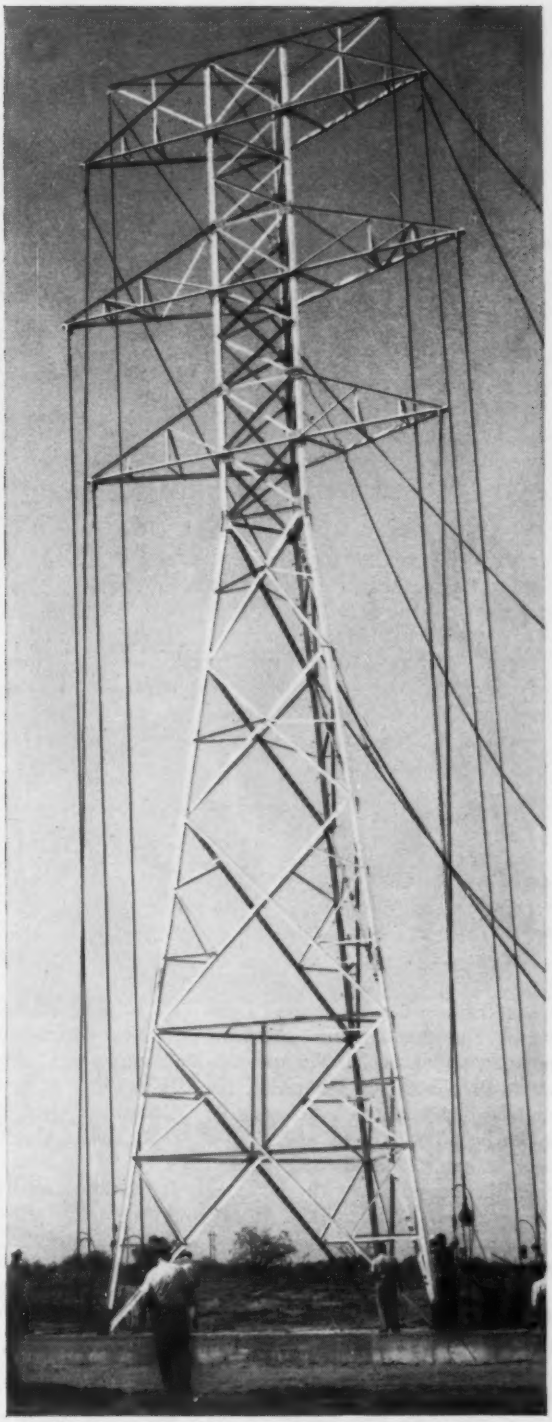
From design, through fabrication, erection, and maintenance—aluminum offers proved advantages in substations and transmission towers.

At Phoenix, Arizona, Reynolds Structural Fabricating Division is designing, fabricating, and assembling entirely new structures that make maximum use of aluminum's advantages. Because aluminum is light in weight, fabrication and assembly are simplified. Because aluminum combines strength with light weight, structure weight can be reduced 60 to 70% or more while retaining load-carrying capacities of structures made of heavier metals. And these lighter weight structures naturally cost less to ship, cost less to erect. (Helicopters can even be used to transport completely assembled units to inaccessible areas).

Once the structure is up, additional savings are realized. Aluminum is corrosion-resistant and can never, ever rust. It's the perfect material for structures located in coastal areas or in industrial atmospheres. The cost of maintenance painting is eliminated. Aluminum also ends the problem of painting "hot" structures and the costly practice of shutdowns for maintenance.

Reynolds can offer a complete series of standard aluminum structural shapes or design new shapes to fit your substation or tower requirements. New types of transmission towers are constantly being designed, fabricated and tested at Reynolds Phoenix Division.

For complete information on aluminum substations and towers that can result in major savings for you, write *Reynolds Metals Company, P.O. Box 2346-EL, Richmond 18, Virginia.*



This three-legged tower has all the strength of the conventional four-legged designs, yet is only one-third the weight. Strong, specially designed aluminum extrusions make this metal savings possible as well as lowering handling and construction costs.

REYNOLDS ALUMINUM

Watch Reynolds TV show "Harrigan & Son," Fridays; also "All Star Golf," Saturdays—ABC-TV

Sierra Pacific Power Appoints President And Board Chairman

TRACY FLETCHER

Frank A. Tracy has been elected chairman of the board of Sierra Pacific Power Co while Fred L. Fletcher was named to succeed him as president of the company.

In the utility business 41 years, Tracy has held posts with Ponce Electric Co, Blackstone Valley Gas & Electric Co, and as expert engineer analyst for the Securities & Exchange Commission.

Head of the rates and analysis department and personnel director at Stone & Webster Service Corp prior to joining Sierra Pacific as manager in 1940, he became president in 1942.

Fletcher began his utility career 31 years ago with Sierra Pacific. He subsequently served with the Nevada State Highway Department and Central Illinois Electric & Gas Co. He was a vice president of Central Illinois E&G before his return to Sierra Pacific last year as executive vice president.

PERSONAL BRIEFS

Potomac Edison Co has made **William E. Elgin** assistant system operating manager.

Detroit Edison Co has named **Lynden J. Kaufmann** union relations manager, and **John M. Maguire** administrative head of the union relations department. **George J. Brown** became assistant manager of construction; **Donald H. Corey,** general superintendent of the construction and maintenance department; and **Harold S. Jensen,** assistant general superintendent.

Metropolitan Edison Co has named **Robert F. Giles** residential and farm sales supervisor in the Reading area, replacing **Charles F. Botwright** who was transferred to the sales department of Pennsylvania Electric Co's Altoona district.

Iowa Electric Light & Power Co has promoted **Peter A. Stover** to director of purchasing and stores, replacing retired **Marvin Wright.**

Ernest C. Gaston, president of Southern Services, Inc, has been elected a director of Southern Co, replacing **H. J. Scholz** who resigned.

R. E. Tweeddale, general manager of New Brunswick Electric Power Commission, has been named "Electrical Man of the Year" for Canada by the electrical publications of the Hugh C. MacLean Co.

J. M. Harding has been re-elected president of the Omaha Public Power District.

George Allen has been named supervisor of insurance and auditing for Southwestern Electric Service Co.

Robert P. Blass has become industrial sales engineer in Arkansas Power & Light Co's Little Rock division.

Atlantic City Electric Co's **Howard H. Melvin** has retired as vice president. He will continue as a director.

Ebasco Services Inc has named **Lewis C. Maull** manager of management consulting services for the south-central regional office.

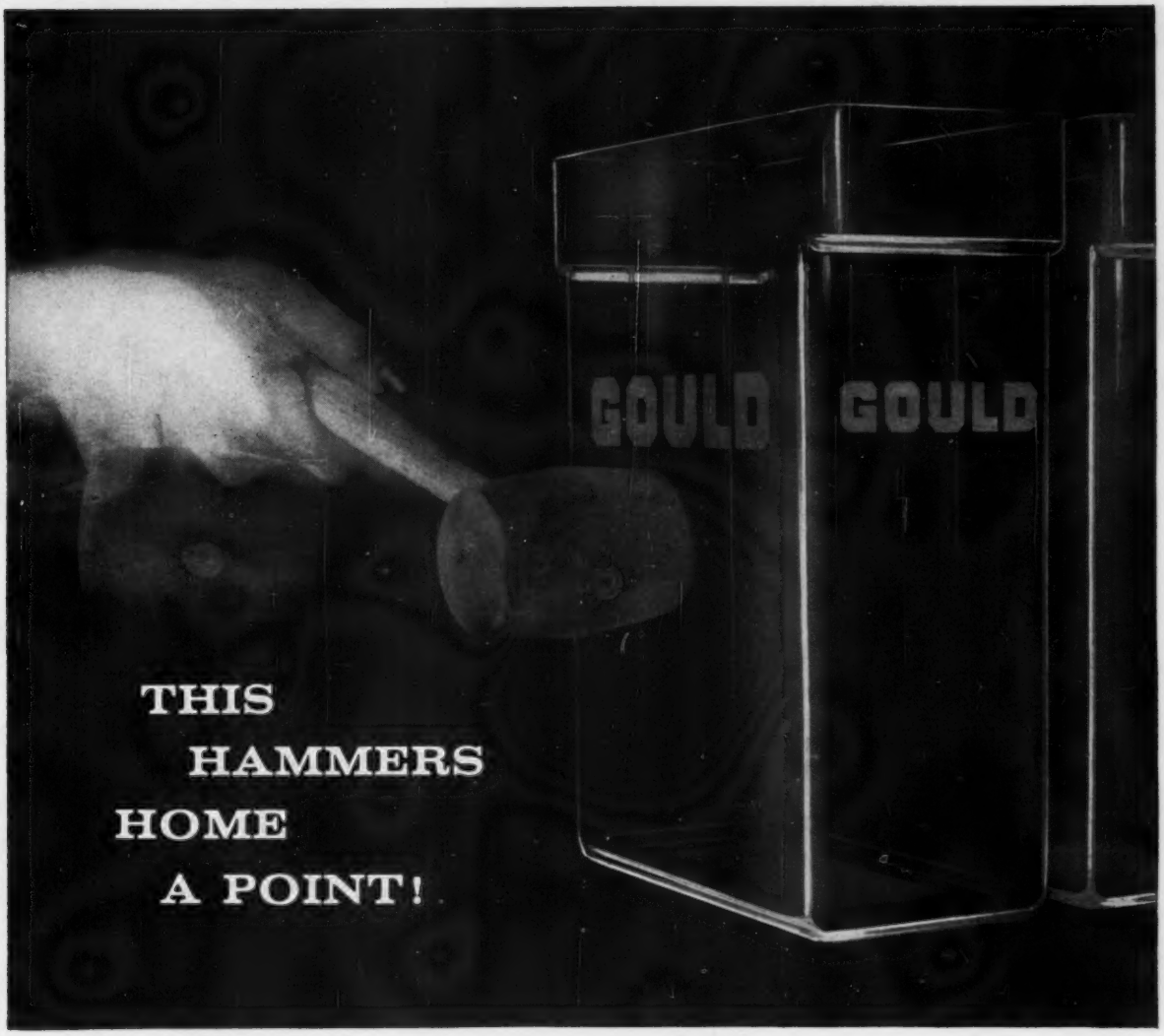
The Oklahoma City division manager for Oklahoma Gas & Electric Co, **Leo O'Brien,** has retired.

Ralph Whitney has become Green Mountain Power Corp commercial manager.

Wisconsin Electric Power Co has promoted **Joseph D. Wolfe** to assistant to the station operation division superintendent; **James J. Wolak** to assistant to the station construction division superintendent; and **James M. Mc Cowen** to assistant to the trouble, local agents, and street lighting division superintendent.

At Public Service Co of Indiana, **J. B. Hoffner** has become power production superintendent, and **L. W. Leath** has been named Edwardsport Station superintendent.

(*More News About People, p* 102)



Gould Stationary Battery Jars are Practically Indestructible

New Stationary Batteries in Plastrite Jars offer the same long life for which Gould has always been famous.

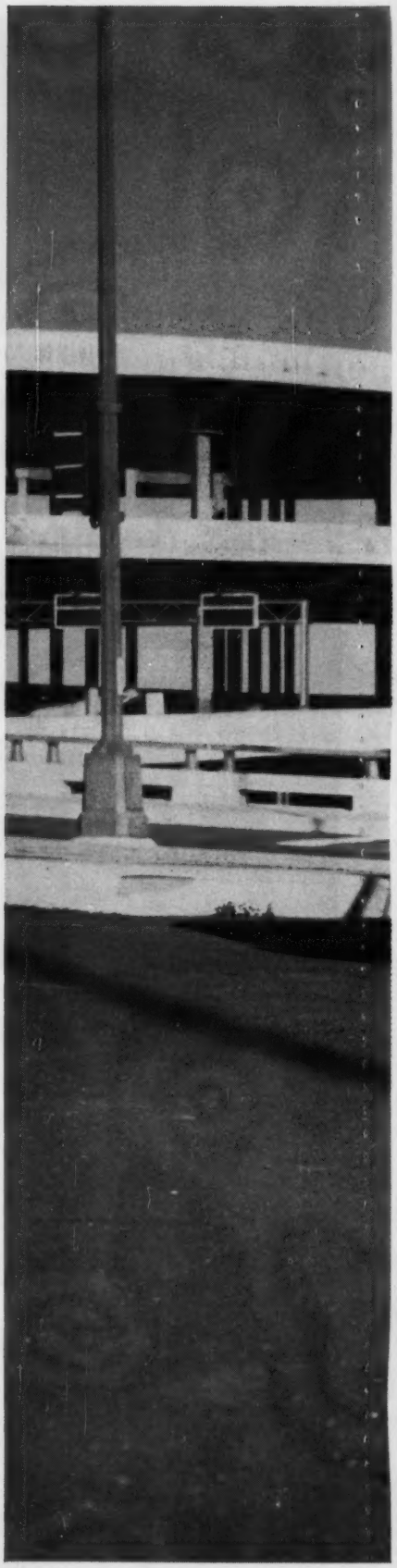
Gould Plastrite Jars have a higher tensile strength than most Stationary Battery Jars . . . will withstand greater impact than ever before! This means you'll be free from breakage in handling and shipping.

Plastrite Jars are a feature of Gould's all new batteries for stationary service. Lighter weight makes the jars easier to handle . . . original shape maintained because of higher heat resistance, higher elongation characteristics of Plastrite material.

Same Capacity, Smaller Size. Gould Plastrite Jars save you 30-40% floor space . . . give you the same capacity in a smaller size battery. They're available in Planté, Calcium, and Kathanode. For more details, write today or call your local Gould Office listed under "Batteries—Industrial" in the "Yellow Pages." Gould-National Batteries, Inc., First National Bank Building, St. Paul 1, Minnesota. In Canada, write to Gould-National Batteries of Canada, Ltd., 1819 Yonge Street, Toronto, Ontario.

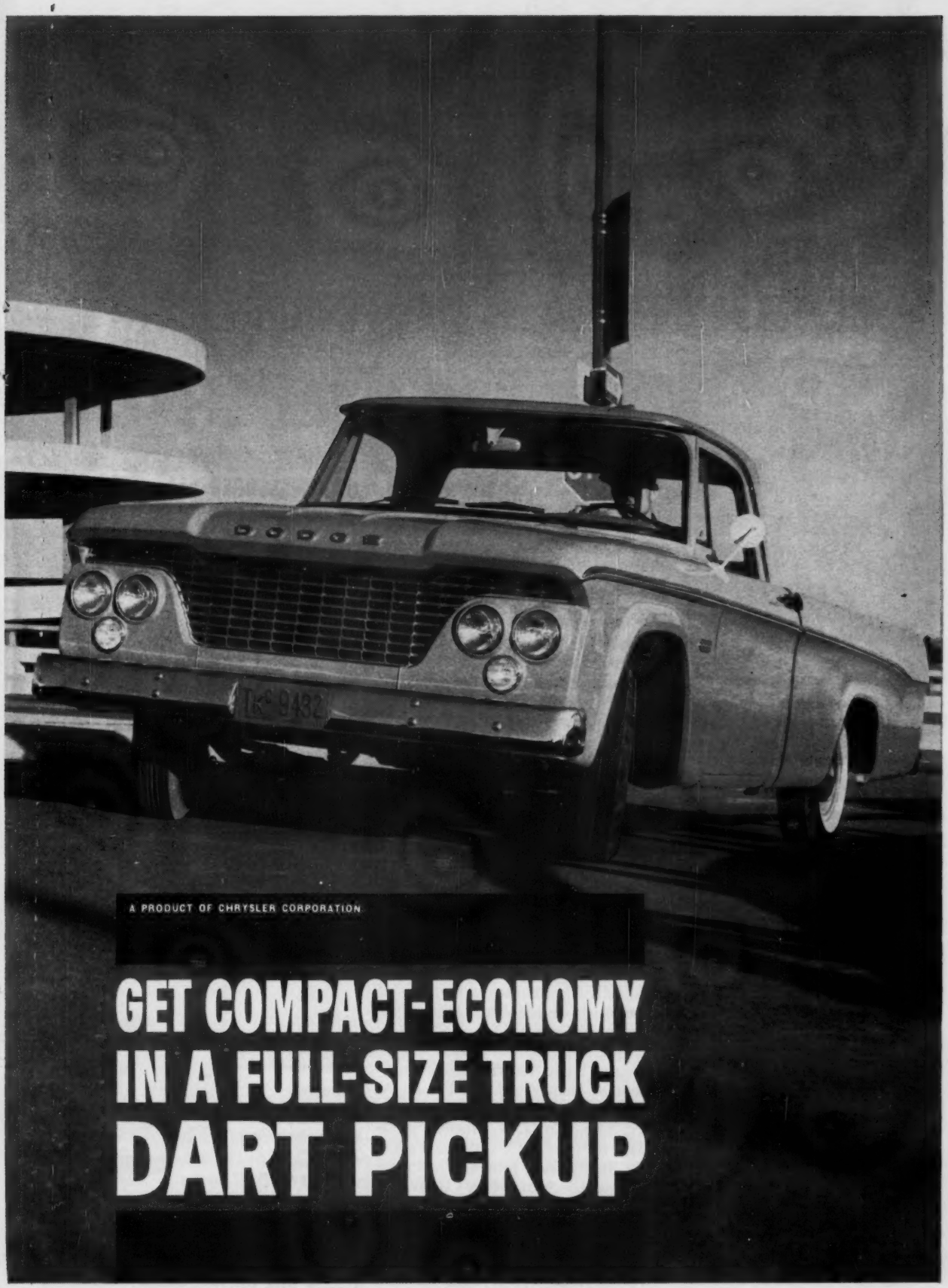
More Power to You from **GOULD**

DODGE TRADESMAN has a place for everything. Does something about the weather, too. Keeps your tools and equipment out of it. Has vertical and horizontal compartments, with locks on both sides. With all-new 140 HP Dart Power-6 or 200 HP V8, 2- or 4-wheel drive.



Here's a full half-ton hauler that takes the toughest jobs in stride. Available with either a six-and-a-half or eight foot box, it offers you more load space, more room for profit than any competitive pickup on the road today! But the Dart Pickup delivers more than space and muscle. It's the first and only full-size truck with compact-economy! Its diet is compact. Upkeep costs, too. It's compact in everything but work capacity and roadability. In actual miles-per-gallon tests, the Dart Pickup repeatedly beat its major competition . . . both Ford and Chevrolet. The Dart Pickup is also available with an efficient, high-performance V8. (Both engines thrive on regular gasoline.) Other money-saving ways? Sure! This pickup is specially treated to prevent rust. Helps keep maintenance costs down . . . and its trade-in value up. The Dart Pickup stays tight and clean. How's it priced? Right down the line with every pickup going. If you're looking for genuine value, visit your dependable Dodge Dealer. He's got it . . . the half-ton Dart Pickup.

DODGE BUILDS TOUGH TRUCKS


A PRODUCT OF CHRYSLER CORPORATION
GET COMPACT-ECONOMY
IN A FULL-SIZE TRUCK
DART PICKUP

Ashes, coal and other substances under foot often make solid floors in boiler rooms unsafe.

Such hazardous materials cannot accumulate on a floor made of Irving open steel grating. Debris falls right through, making floors always clean. Dangerous fumes can escape through open grating. Floors made of Irving Grating are clean, safe at all times . . . no ankle turning, tripping, slipping, hot foots. It is fireproof, self-ventilating.

Manufacturers of Riveted, Pressure-Locked, and Welded Gratings of Steel, Aluminum and other metals.

"A FITTING GRATING FOR EVERY PURPOSE"

IRVICO

IRVING SUBWAY GRATING CO., Inc.
Originators of The Grating Industry Est. 1902
Offices and Plants at:
5067 27th St., LONG ISLAND CITY 1, N.Y.
1867 10th St., OAKLAND 20, CALIFORNIA

Philip H. Viles has been appointed a member of the Grand River Dam Authority.

M. E. Culbertson has been named to succeed **E. C. Russell** who retired as Ohio Power Co's local manager at Dillonvale. Also, **W. E. Dunfee** was appointed eastern division meter superintendent.

Richard J. Thompson has been elected to a six-year term on the North Dakota Public Service Commission.

Everett D. Smith has been promoted to assistant supervisor of electric construction for Dayton Power & Light Co.

Idaho Power Co has named **J. F. Emery,** who was vice president for engineering, to be vice president and assistant general manager.

Carroll L. Proctor, who retired from the board of Toledo Edison Co, has been succeeded by **Alois Hoefle.**

At Central Illinois Light Co, **Charles Smith** has succeeded **Carl Lebkuecher** who retired as electric distribution department superintendent. **Ernest E. Knoedler** became assistant superintendent.

Clause R. Groth has retired as assistant secretary and assistant treasurer of Pacific Power & Light Co.

A. E. Brown has been named 1961 president of the Inland Empire Electrical League, succeeding **C. A. Pierce. Earl Stout** became vice president.

Willis Gale, chairman of Commonwealth Edison Co, has been named executive committee chairman of the newly established research division of Edison Electric Institute. Committee members are **P. A. Fleger,** board chairman and president of Duquesne Light Co; **R. A. Gibson,** president of Hartford Electric Light Co; **J. K. Horton,** president of Southern California Edison Co; **D. C. Luce,** president of Public Service Electric & Gas Co; **W. W. Lynch,** board chairman and president of Texas Power & Light Co; and **W. O. Turner,** board chairman of Louisiana Power & Light Co.
(*More News About People, p* 104)

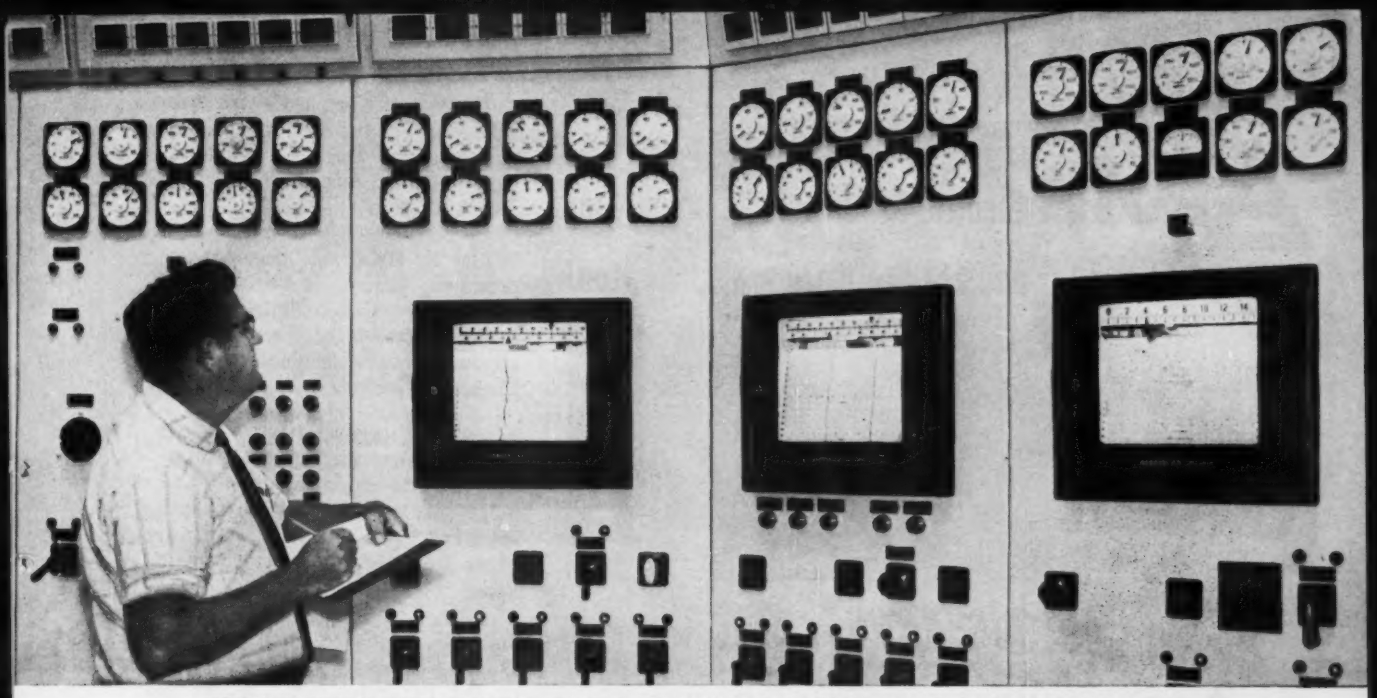
GALVANIZED STEEL STRAND FOR GUY, MESSENGER and OVERHEAD GROUND WIRE

The high, uniform, consistently-dependable quality of Crapo Galvanized Steel Strand is the direct result of close laboratory control over each step in manufacture. All wires used in forming a particular size and grade are produced from steel of selected analysis, carefully processed under technical supervision and stranded on precision machines. Both wire and finished strand are subjected to prescribed laboratory tests to insure the desired end result.

Heavy, uniform, tightly-bonded zinc coatings, applied by the famous Crapo Galvanizing Process, provide maximum resistance to corrosion.

Write for booklet OG-25 containing "Sag and Tension Data for Overhead Ground Wire."

INDIANA
STEEL & WIRE CO., INC., Muncie, Indiana

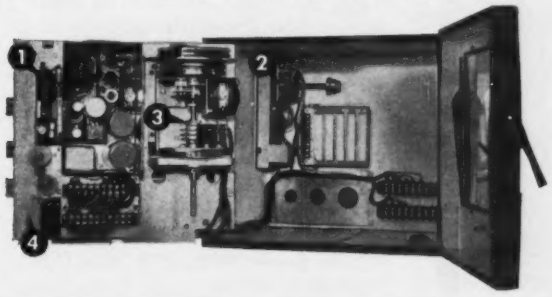


TYPICAL OF GENERAL ELECTRIC UTILITY INSTRUMENTATION is this bank of null-balance recorders and switchboard instruments at Florida Power Corporation, one of more than 80 utilities benefiting from the accuracy and reliability of G-E Recorders.

General Electric Recorder Reliability

Application-proved in Utility Systems Throughout the World

Today, more than ever before, utilities demand the greatest possible recording instrument reliability for monitoring electrical and physical parameters accurately. That is why General Electric, long established in quality instrumentation, offers you a *complete line* of null-balance recorders and recording controllers designed for accuracy, ease of calibration and dependable operation, to meet *all utility applications*. More than 80 foreign and domestic utilities depend upon reliable General Electric Recorders to accurately monitor parameters in central stations, substations and distribution systems.



In your central stations alone, General Electric "system engineers" the necessary instrumentation for your particular needs. This means your recorders, switchboard instruments and switchgear equipment are custom-designed in one coordinated "package" *at no additional cost* and delivered and installed *on time*. At Florida Power Corporation this "package" measures generator watts and vars, field and stator temperatures, turbine bearing temperatures and boiler-feed-pump motor temperatures.

With General Electric multi-point, single and two-pen strip and round chart recorders, *(all ¼% accuracy class, of course)* reliable performance begins on the *inside!* Here are four reasons why:

1. **Silicon diode reference source provides continuous standardization.**
2. **Multi-point selector switch permits remote location.**
3. **Up to 8 control switches; up to 4 transmitting slidewires easily accommodated.**
4. **All components mounted on swing-out panel for easy accessibility.**

GET THE FULL STORY on G.E.'s complete line of recorders and other utility instruments by contacting your nearest G-E Sales Office today; or write to Section 599-05, General Electric Co., Schenectady 5, N. Y., for your free, complete package of descriptive, utility-oriented literature. In Canada, contact Canadian General Electric Co., Limited, 940 Lansdowne Ave., Toronto 4, Ontario.

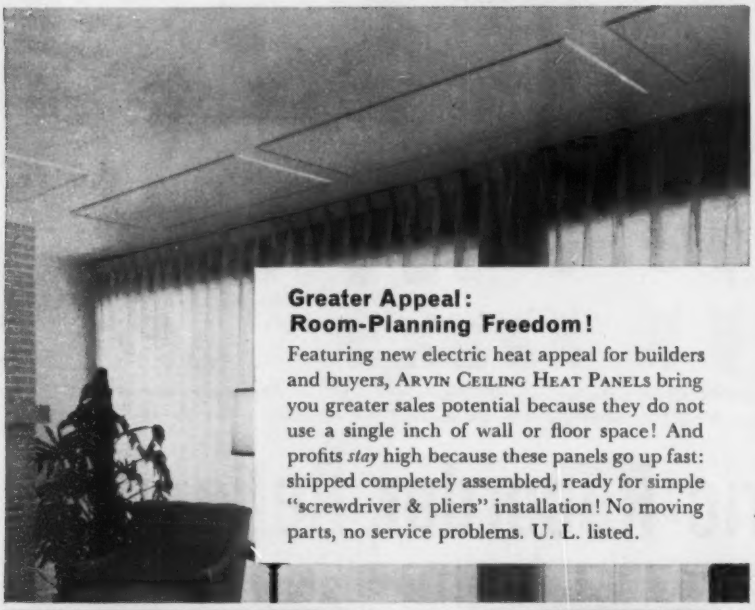
OTHER G-E INSTRUMENTS FOR ELECTRIC UTILITIES: Turbine Supervisory Instrumentation • Switchboard & Panel Instruments • Electric Recorders Automatic Dispatching Systems • High-Accuracy Portables • Vibration Indicators & Recorders • Hook-On Indicators & Recorders • Telemetering Systems

INSTRUMENT DEPARTMENT

GENERAL ELECTRIC

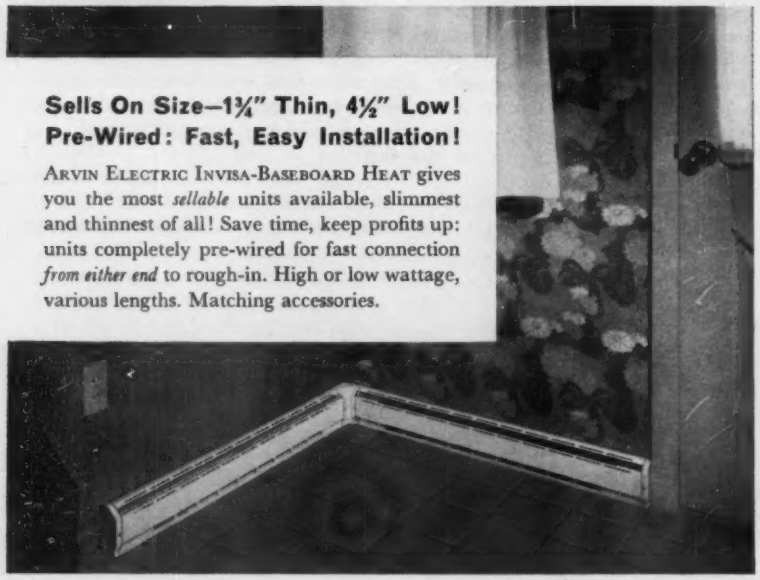
consumer tested and proved

Arvin Electric Invisa-Panels solve your space problems . . . and they're more profitable, too!



Greater Appeal: Room-Planning Freedom!

Featuring new electric heat appeal for builders and buyers, ARVIN CEILING HEAT PANELS bring you greater sales potential because they do not use a single inch of wall or floor space! And profits *stay* high because these panels go up fast: shipped completely assembled, ready for simple "screwdriver & pliers" installation! No moving parts, no service problems. U. L. listed.



Sells On Size—1¼" Thin, 4½" Low! Pre-Wired: Fast, Easy Installation!

ARVIN ELECTRIC INVISA-BASEBOARD HEAT gives you the most *sellable* units available, slimmest and thinnest of all! Save time, keep profits up: units completely pre-wired for fast connection *from either end* to rough-in. High or low wattage, various lengths. Matching accessories.

ARVIN BUILT-IN WALL HEATERS

A complete line—seven fan-forced radiant models, from 3413 to 13,652 BTU capacities. Instant-heating elements. Each model features new-design rough-in box, quick-fastening clamps for new or old construction.

Write or call Arvin for facts and folders. No obligation.

Arvin®
Electric Heat Division
ARVIN INDUSTRIES, INC. · COLUMBUS, INDIANA

A LEADING NAME IN ELECTRIC HEAT PRODUCTS FOR 28 YEARS

Chase Brass & Copper Co, Inc, subsidiary of Kennecott Copper Corp, has appointed **David S. Soliday Jr** as marketing manager-warehouse division.

Walter S. Bopp has become vice president, general manager, international division, Philco Corp. **Lester P. Creaser** has become semiconductor sales engineer of the Lansdale division.

Electric Storage Battery Co has formed a new marketing organization for its exide industrial and nickel-alkaline divisions. The new organization is headed by **C. J. Moore,** exide's vice president-marketing.

John V. McGuire has succeeded **D. A. Griffith** as general manager of the Pittsburgh, Pa., Works of Allis-Chalmers Manufacturing Co. Griffith was named purchasing agent for the Works. **Gene S. Melton** became the industries group's service manager in the Northeast region.

Sylvania Electric Products Inc, subsidiary of General Telephone & Electronics Corp, has named **Max E. Doney** Cincinnati district sales manager for the lighting products division.

Remington Rand Univac division of Sperry Rand Corp has appointed **Richard P. Castanias** western regional sales manager for Univac scientific computers. **Clarence P. Wolfe** succeeded Castanias as manager of the division's military applications offices in Los Angeles. **A. R. Shriver** has become manager of the newly created user relations department of the Univac division.

Walther H. Feldmann, president of Worthington Corp, has been named chief executive officer, succeeding **Hobart C. Ramsey** who will continue as chairman.

Raymond G. Nordstrom has joined Hevi-Duty Electric Co as executive vice president.

Federal Pacific Electric Co has reorganized its manufacturing operations by integrating 16 of its plants into three regional groups headed by **John T. Romano, Clif-**

ford E. Harris, and **Leonard P. Shelley.**

Shannon C. Powers has been promoted to general manager of national electric division of H. K. Porter Co, Inc.

J. H. Dennis, manager of manufacturing, has assumed responsibility for all manufacturing divisions and operation of Bailey Meter Co's three Cleveland plants, replacing Vice President **C. E. Sutherland** who retired.

Electric Autolite Co has elected **George A. Dauphinais** vice president and assistant to the president.

Westinghouse Electric Corp has merged its small steam turbine and industrial gas turbine departments within the steam division. The new small steam and gas turbine department is headed by **R. C. Twombly,** with **J. D. Moise** as his assistant. **K. S. Kramer** and **F. Anthony** are the engineering and sales managers for the department, and **E. J. Fogel** is manufacturing manager.

Robert G. Lenox has joined the market research group of Raytheon Co's semiconductor division.

Wayne T. Marshall has been named sales service manager for Babcock & Wilcox Co's refractories division.

Robert B. Fulton has been elected president of the Sequoia Wire & Cable Co, wholly-owned subsidiary of Anaconda Wire & Cable Co. Other officers elected were: **William L. Grey,** executive vice president; **James L. Vincent,** secretary and treasurer; and **Herbert B. Fields** as assistant secretary and treasurer. **Charles E. Van Hoy** has been promoted to manager of Anaconda Wire & Cable Co's Orange, Calif., mill. **John A. Barris** became Sycamore, Ill., plant superintendent, and **James P. Ruch** became assistant superintendent at Muskegon, Mich.

Union Carbide Plastics Co has promoted **Philip A. Thomas** to assistant director-development.

Combustion Engineering, Inc, has named **Carmine J. Grossi,** export

(*Continued on page* 106)

SAFETY by-the-MILE

with CF&I Galvanized Steel Strand

CF&I Galvanized Steel Strand used as overhead ground wire safeguards your power cables all along the line. It takes the punishment from lightning and shunts it harmlessly aside.

This kind of safety is inherent in every foot of CF&I Galvanized Steel Strand. The wire is expertly drawn from selected steels. After the wire is hot-dipped in zinc for extra weather resistance, it is stranded. The quality controls used in each manufacturing operation assure a strong, safe, dependable grounding wire.

For standard applications, CF&I Galvanized Steel Strand is made to ASTM specification A-363 in seven- and three-wire constructions. For special applications CF&I is equipped to manufacture strand to your own specifications.

For complete details and delivery schedules, contact your local electrical distributor.

CF&I STEEL

GALVANIZED STEEL STRAND
THE COLORADO FUEL AND IRON CORPORATION

In the West: THE COLORADO FUEL AND IRON CORPORATION — Albuquerque • Amarillo • Billings • Boise Butte • Denver • El Paso • Farmington (N. M.) • Ft. Worth • Houston • Kansas City • Lincoln • Los Angeles Oakland • Oklahoma City • Phoenix • Portland • Pueblo • Salt Lake City • San Francisco • San Leandro Seattle • Spokane • Wichita

In the East: WICKWIRE SPENCER STEEL DIVISION — Atlanta • Boston • Buffalo • Chicago • Detroit New Orleans • New York • Philadelphia

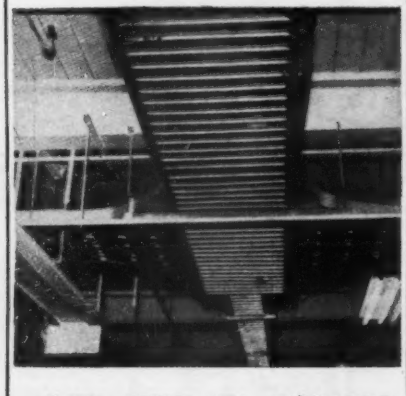
CF&I OFFICE IN CANADA: Montreal

CANADIAN REPRESENTATIVES AT: Calgary • Edmonton • Vancouver • Winnipeg

Save Time, Money Speed Installations with . . .

P-W

CABLE SUPPORTING SYSTEMS



P-W's TYPE "E" (PUNCHED BOTTOM) TRAYS—FOR POWER AND CONTROL CABLES AND INSTRUMENT TUBING—ALTHO LESS EXPENSIVE, ARE STRONGER, VERSATILE AND SUPERIOR. CONTROL CABLE CAN BE DROPPED OUT ANYWHERE.

Engineers, Contractors and Installers look for QUALITY, LONG LIFE, AND LABOR SAVINGS in their supports. That's why more and more users are turning to P-W. Among our outstanding improvements are: CONNECTIONS that are quick and easy to install—PRE-CUT SYSTEMS saving installation time—EXTENSION CONNECTORS eliminating field cutting to complete runs — ADJUSTABLE HORIZONTAL and RISER CONNECTORS to go over, under or around pipes, trusses, columns, etc. — BUILT-IN ADJUSTABLE DROP-OUT SECTIONS eliminate cutting out bottom of tray — STRAIGHT SECTIONS available in lengths up to 16' (33⅓% less connectors and less installation time over 12' lengths).

P-W SUPPORTS are available in hot dip galvanized steel or aluminum, in LADDER, EXPANDED METAL and SOLID TRAYS in addition to Type "E". All systems are interchangeable. Write for Catalog 858-A.

For the utmost in service, contact the appropriate Representative in your territory or P-W direct, regarding inquiries and placing orders.

P-W INDUSTRIES
11200 Roosevelt Blvd.
Philadelphia 15, Pa.

sales manager, as vice president.

De Laval Steam Turbine Co has appointed **M. B. Sennet** as assistant to the vice president and **Donald T. Bixby** as IMO department manager.

McGraw-Edison Co's Line Material Industries has promoted **H. R. Rowe** to product manager of protective equipment and capacitors. **R. H. Draeger** was named supervisor of capacitor sales and service.

L. D. T. Berg, manager of the equipment marketing department of Air Reduction Sales Co, a division of Air Reduction Co, has been elected chairman of the arc welding section National Electrical Manufacturers Assn, succeeding **Robert T. Brown,** general manager, welding products division, Metal & Thermit Corp. **Marvin G. Sedam,** executive vice president of Alloy Rods Co, succeeded Berg as vice chairman of NEMA section. **J. Stanford Smith,** general manager of the outdoor lighting department, General Electric Co, was elected chairman of the street lighting section of NEMA. He succeeded **E. B. Karns,** product manager, outdoor lighting, lighting division, Westinghouse Electric Corp. **F. A. Rudolph,** Ripley Co president, was named vice chairman, and **K. C. Dorland,** manager, outdoor lighting products, Union Metal Manufacturing Co, was elected to represent the section on the board of directors of the NEMA lighting equipment division.

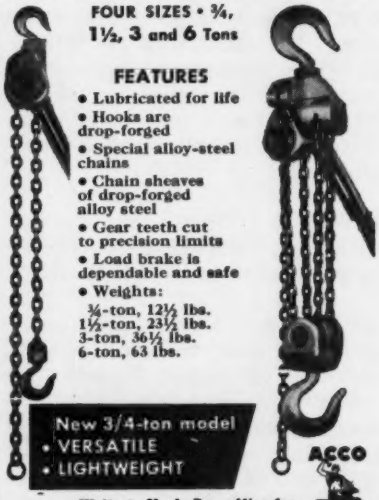
Square D Co has named **John N. Daniel** commercial control division manager.

OBITUARIES

Horace B. Perry, 67, former senior vice president, Jackson & Moreland Inc . . . **Frederick E. Hertel,** 68, former assistant manager, Stone & Webster Engineering Corp . . . **Frank Lanier Strong,** 52, electrical engineer, Mississippi Power & Light Co . . . **Lynell E. Strickland,** 37, utility foreman, Baton Rouge T&D department, Gulf States Utilities Co . . . **Samuel Wilson Greenland,** 83, former vice president and general manager, Indiana Service Corp.

NEW ¾-ton Pull-A-Way

Added to WRIGHT TYPE "C" LINE!



FOUR SIZES • ¾, 1½, 3 and 6 Tons

FEATURES
- Lubricated for life
- Hooks are drop-forged
- Special alloy-steel chains
- Chain sheaves of drop-forged alloy steel
- Gear teeth cut to precision limits
- Load brake is dependable and safe
- Weights:
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  1½-ton, 23½ lbs.
  3-ton, 36½ lbs.
  6-ton, 63 lbs.

New 3/4-ton model
• VERSATILE
• LIGHTWEIGHT

ACCO

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DIELECTRIC TEST EQUIPMENT

40 KV Model is a one-man portable set for maintenance d-c tests. Maximum safety built in. Simple operation. Reliable performance. You get excellent output voltage with facilities for voltage and leakage current measurements.

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Write for BULLETIN 22-W.

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Electrical and Speed Measuring Equipment
1316 Arch Street, Philadelphia 7, Pa.

SALES ASSIGNMENTS

COMPANY STAFFS

Westinghouse Electric Corp has appointed Robert J. Sampson Detroit district sales manager for the lamp division.

Kuhlman Electric Co has named Kuhlman Fluehr as western regional sales manager. Fleuhr, with his office at the company's Salinas, Calif., factory, directs the transformer sales staff covering the Pacific Coast area.

Radio Corp of America has promoted Raymond J. Fichthorn to eastern sales representative for microwave equipment and systems sales in states east of the Mississippi River. His headquarters are in Camden, N. J.

Continental-Diamond Fibre Corp has assigned John C. Soult sales representative in the Chicago district office.

Air Reduction Sales Co has appointed R. H. Merriman Philadelphia district sales manager.

I-T-E Circuit Breaker Co has established seven new geographical marketing areas, replacing the previous four-sales-region division of the country. The marketing areas, managers and sales offices in these areas are: North Atlantic, Harry G. Johnson, Boston; Mid-Atlantic, Louis H. Hopper, New York City; Southern, George R. Hoffman, Atlanta; Midwest, Robert C. Engemoen, Chicago; Pacific, Robert G. Petersen, San Francisco; Central, John Donald Akers; and Southwest, Paul E. Morgan. Central and Southwest office locations have not been assigned.

REPRESENTATIVES

Fisher-Pierce Division of Sigma Instruments Inc has appointed Bowen-Arnold Agency as a sales representative, covering Florida except for the area west of the Apalachicola River. The agency has offices at 190 SE 14th Terrace, Miami, and at 4228 Cortez Way South, St. Petersburg.

Allis-Chalmers Manufacturing Co has named a new distributor and agency in Tennessee for various Industries Group products. The distributor, Ocoee Electric Supply Co, Church at 18th SE, Cleveland, will handle A-C motors and control equipment in Tennessee's Bradley county. Meter Service & Supply Co, 1496 Humber St, Memphis, an A-C distributor, became an agency in Tennessee for the company's capacitors.

Unsurpassed in Metering

Unique Magnetic System

free-floating...surge resistant...self-cleaning

The true magnetic flotation principle used in the Sangamo J3 Watthour Meter is unique! Two bonded cylindrical Alnico magnets with opposing magnetic fields float the disk freely.

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true MAGNETIC flotation J3

SANGAMO ELECTRIC COMPANY

SPRINGFIELD ILLINOIS

PW61-3

Power Planning Hinges on Natural Resources

(*Continued from page* 67)

primary cable is installed, and at locations where future digging can be anticipated. A continuing program has been set up to educate contractors and residents about protecting the underground plant.

Cable for 4-kv phase conductors is PVC-jacketed, shielded polyethylene over copper, adopted because of its low cost and satisfactory performance in other installations. Secondaries and services are polyethylene-insulated aluminum triplex, sized for estimated ultimate loading of 16.5 kw per home with all connections made in 46 transformer kiosks or service pedestals served by secondary mains.

Transformers were sized to reach 115% of nameplate after ten years of load growth, Moull said. Each one will serve from four to 14 homes, depending on lot configuration, and is housed in a semi-buried square kiosk projecting only 28 in. above grade. These kiosks will accept a self-protected transformer up to 75 kva and bayonet cutouts for protection and switching of each incoming and outgoing primary cable and the transformer itself. Circuit configuration permits any kiosk to be completely de-energized by opening cutouts in adjacent kiosks while damage is located and repaired or new services connected.

Nova Scotia Light & Power Co's first "lower-cost underground" installation, to serve a 300-unit group including a school, pumping station, and sewage plant, has 15-kv, Neoprene-jacketed, shielded, rubber-insulated No. 2 copper cables, reported G. C. King. These cables are direct-buried in the naturally sandy soil and covered by treated planks for mechanical protection. They are arranged to provide loop feed from the overhead system to eight pad-mounted transformers, each with three hook-stick-operated sectionalizing switches in its primary compartment.

Residential units and street lights are served by direct-buried, rubber-insulated, 600-v cable directly from the transformers, without secondary mains, King said. Protection is provided by primary links and secondary breakers in each transformer.

Lower cost underground systems have a character quite different from conventional encased-duct systems common to high-density areas, suggested G. A. Piper, Ontario Hydro. It is important to plan the installation carefully to develop the best design, as capacity and voltage changes are more difficult than for overhead systems. Interruptions should be less frequent than those of overhead systems, but an underground system must be designed for prompt, safe maintenance without prolonged or extensive interruptions, he said.

Overhead distribution engineers "may find ourselves out of a job some day," said Maurice St-Jacques, Hydro-Quebec. But an acceptable overhead system can still be built, making the lines acceptable by hiding them as in rear-lot

(*Continued on page* 110)

MULTIPLEX SPREADER CO.
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Manufacturer of the Only Practical Spacer for Midspan Connection on Spun or Tri-plex Secondary

SAFE, ECONOMICAL, SIMPLE INSTALLATION
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Construction Supervision, Construction Engineer for inspection and supervisory work on electric power lines and substations. Opportunity for permanent employment and advancement with well-known consulting engineering firm. Send resume to P-6001, Electrical World.

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Wanted—Graduate Electrical Engineer. Opportunity for a graduate Electrical Engineer to serve as Assistant Superintendent of a Municipal Electric Plant in Eastern Massachusetts. Experience in Transmission, Distribution and Plant Management desired. Please answer, giving education, experience and salary expected. Write to P-6290, Electrical World.

Manager-Rural cooperative, Western Kentucky, 1,500 miles of lines, approx. 10,000 members, approx. $4,000,000 plant, outstanding indebtedness $600,000. Application forms will be sent if requested before May 1, 1961. Write Horace Harting, President, Jackson Purchase R.E.C.C., 2315 Broadway, Paducah, Kentucky.

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-5551) will be received at Denver, Colorado, until 2 p.m., Mountain Standard Time, April 20, 1961, for furnishing four 115-kv, 1,200-amp, 5,000,000-kva and three 46-kv, 1,200-amp 500,000-kva power circuit breakers for Morris Substation, Missouri River Basin Project. Delivery is desired within 300 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver, Colorado.

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ENGINEERS, PHYSICISTS and MATHEMATICIANS

HINKLEY POINT	—	500,000 KW ATOMIC POWER STATION (in construction, commissioning 1962)
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The English Electric Company Limited of Whetstone, England, has the responsibility for the design and construction of the complete reactors as well as conventional power plant and equipment for these two major atomic power stations, the largest projects of their kind in the world.

The Company is seeking Engineers, Physicists and Mathematicians to participate in this work and also in new developments associated with advanced gas cooled reactors, organic moderated reactors and other systems.

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Resumes should be sent to E. S. Dean, Room No. 1918, 750 Third Avenue, New York City 17, New York.

Selected Applicants will subsequently be interviewed at convenient locations in the U. S. A. by the Chief Engineer, or his Deputy, of the Atomic Power Division of The English Electric Company Limited.

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Nationally known consulting firm has openings for engineering graduates with knowledge of public utility property. Work economic rather than design or construction. Age limit 45. Replies will be held in confidence.

P-6325, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

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Either a **SALES ENGINEER** with Transmission and Distribution Line Construction experience, or an **ELECTRICAL LINE FOREMAN** or **SUPERINTENDENT** who thinks he can sell.

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P-6319, Electrical World
255 California St., San Francisco 11, Calif.

Power Planning Hinges on Natural Resources (*Continued from page* 108)

distribution. This practice, he said, is more costly because mechanized equipment cannot be used, and the lines are more difficult to maintain, and subject to longer interruptions because of difficulty patroling. But it has won acceptance in new residential areas.

Rear-lot distribution becomes difficult for garden and row-housing developments, he said. And it sometimes fails to provide for primary feeders and sub-transmission. Where such circuits must be added later, he said, it may be better to place them underground to avoid disturbing established overhead plant or to run them between planting-strip trees and houses along the streets.

Street lighting along highways and toll roads has, at times, been served at 600 v. This permits the fluorescent fixtures to be supplied at greater distances from transformers concealed on side roads, he said.

Street lighting at Quebec is provided with series loops of single-wire overhead to 2,500-lumen luminaires on tapered poles 21 ft above ground. These poles, locally fabricated by welding telescoped lengths of steel pipe, have proved more acceptable than concrete, reported P. A. Duchostel, Quebec Power Co.

W. A. Pippy, Shawinigan Water & Power suggested consideration of 480-v secondaries to gain capacity for future loads.

Field-assembled aerial cable for the secondary bus, used in conjunction with triplex aluminum service drops, is an example of progress in streamlining distribution, said H. W. Huestis, Ontario Hydro. Use of a prestressed, 12,000-lb steel messenger to support polyethylene-insulated aluminum conductors and a bare aluminum neutral at a 22-ft grade permits spans up to 250 ft and cuts the combined cost of single-phase primaries, secondaries and poles about 25%.

350-Mw Cowans Ford Will Be Peaking Station (*Continued from page* 63)

handle turbine and generator parts for erection and maintenance. The company, which is doing its own construction, will completely assemble, stack and wind the generator rotors and stators at the site.

For each two generators, there will be one FOA transformer, which will have twin primary and one secondary high-voltage windings. Each transformer will be rated at 201.5 Mva, 13.2-230 kv. Indoor air-blast breakers will be provided in 13.8-kv leads of each generator.

The turbines, 121,000-hp, 105.9-rpm Kaplan units, will have the highest head at 92 ft of any Kaplan machines in the country. Their wheels will measure 22 ft 1 in. in dia and the rotating parts of each will weigh 585,000 lb. Each will have six blades instead of the usual four and will operate with blade angles between 12 and 32 deg.

The lake formed by the dam will have a full-pond surface of 32,500 acres, almost as large as the 38,215-acre combined area of the other ten lakes on the Catawba River. It will have a total storage capacity of 1,093,600 acre-ft and a shoreline of approximately 500 miles.

The dam will be a concrete gravity type with a gated spillway section in the river channel. The spillway, which will have 11 gates, each one 35 ft wide x 28 ft high, will discharge 210,000 cfs. Concrete gravity bulkhead structures will tie the power plant and spillway structures into rolled-fill embankments carried to high ground on each side. Total continuous length of the dam, including earth embankments, will be 6,776 ft and its maximum height, 130 ft. The concrete section of the dam will require 350,000 cu yd of concrete, in which flyash will replace 25% of the cement by weight.

The plant will be operated remotely by way of telephone cable and microwave from Lakewood Substation in Charlotte. On signal the unit will start, come up to speed and synchronize, all automatically, in about two min.

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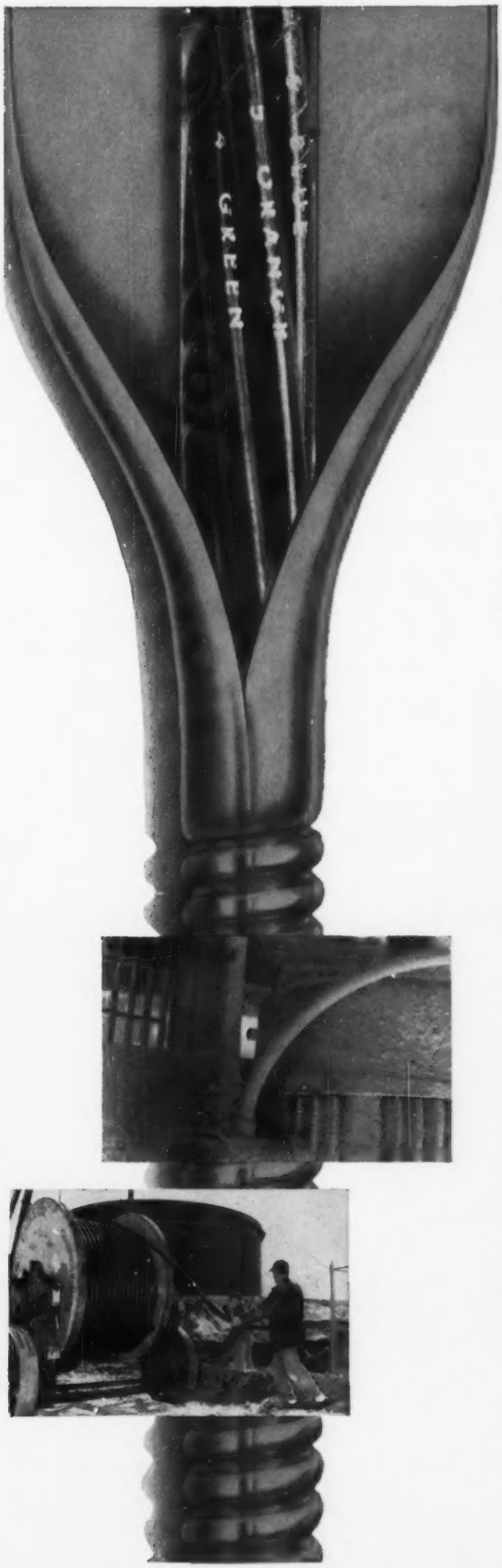

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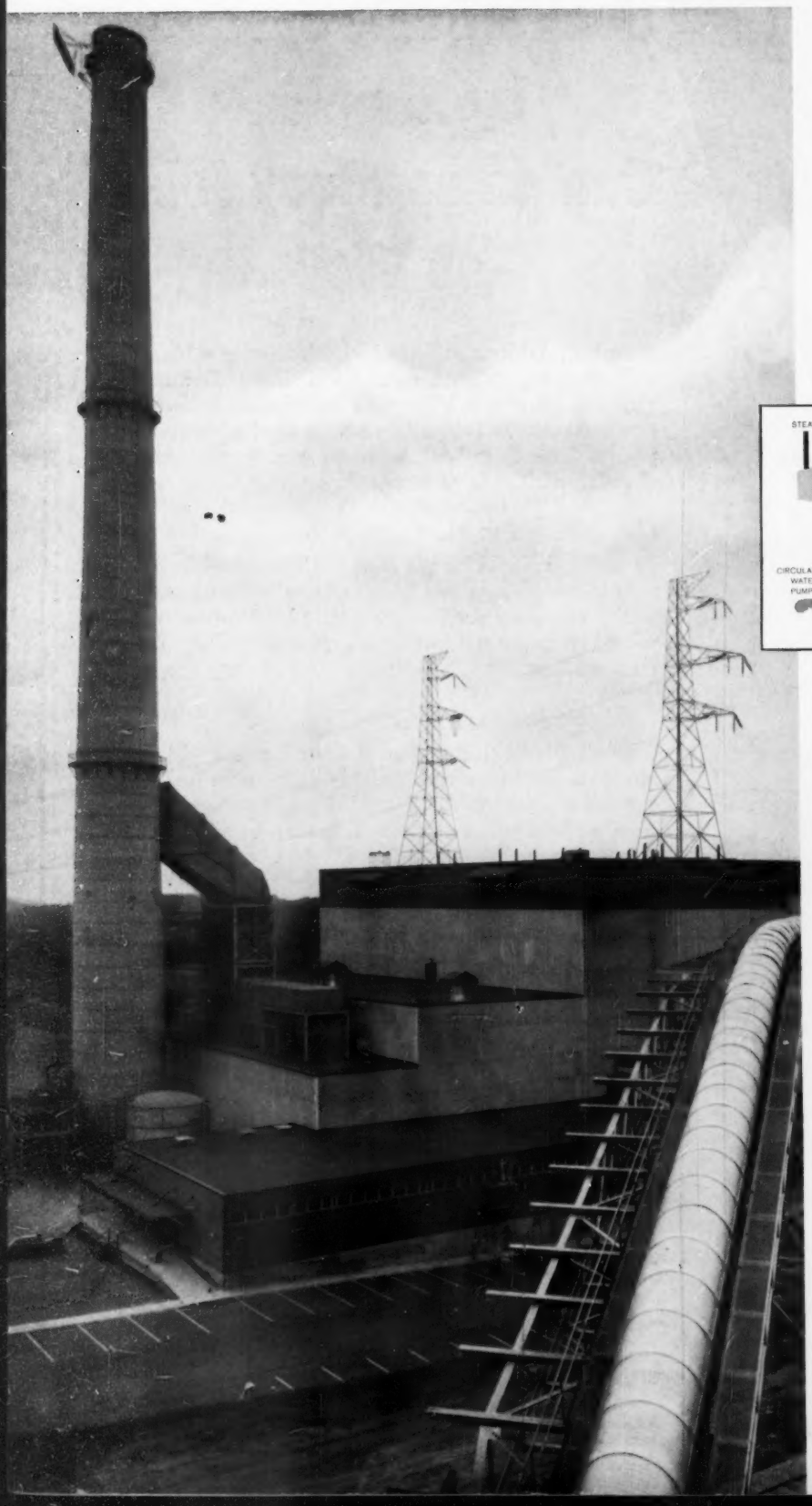
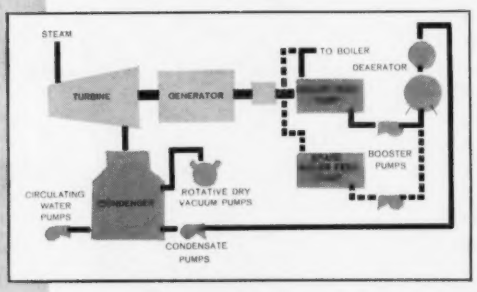


Worthington equipment plays major role in PEPCO achievement

According to the recently issued Federal Power Commission report, Potomac Electric Power Company's Dickerson Station was the most efficient power plant in the U.S. in 1959. PEPCO Engineering Departments worked with Stone & Webster Engineering Corporation to achieve a new low heat rate. Worthington helped by supplying major components in the Fluid Handling Group.



Major fluid handling equipment (shown in red) includes the condensers, circulating water pumps, condensate pumps, rotative dry vacuum pumps, boiler feed and booster pumps and main deaerator to supplement condenser deaeration in protecting the boiler and feed cycle.

The fluid handling equipment incorporates a number of special features. Included is the power-saving technique of a single full capacity boiler feed pump driven from the main turbine generator shaft through a variable speed coupling. There is a spare turbine driven feed pump.

Two duplicate 175 mw units are now in commercial operation. Similar equipment will be furnished for Unit No. 3 scheduled for 1962 operation.

Worthington's successful role at PEPCO Dickerson is the result of "system-wise experience" that Worthington offers as an aid in planning any power project. For information, call your nearest Worthington District Office. Or write to Worthington Corporation, Section 45-19, Harrison, N.J.

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